537.05
E38
W9

PUBLISHED EVERY SATURDAY
168–177 POTTER BUILDING, NEW YORK.
Telephone Call: Murray 586. Cable Address: "Electrical," New York.
New England Office, 48 Congress Street, Boston.
Western Office, 44 Lakeside Building, Chicago.

W. J. JOHNSTON, Editor and Publisher.
T. COMMERFORD MARTIN, JOSEPH WETZLER, Associate Editors.
E. P. THOMPSON, Associate Editor Patent Department.
CLARENCE E. STUMP, Business Manager.

SUBSCRIPTION, IN ADVANCE, ONE YEAR, $3.00.
(Postage Prepaid in the U. S. or Canada.)

CLUBS.—In clubs of 4 or more, $2.50 a year each; with a free extra copy to the getter-up of a club of 8.
Subscription to foreign countries, $4 a year.
In requesting your address changed, give old as well as new address.

THE ELECTRICAL WORLD
HAS THE LARGEST CIRCULATION
OF ANY ELECTRICAL JOURNAL PUBLISHED, AND IS
THE BEST ADVERTISING MEDIUM.

Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions.
Notices of Situations or Help Wanted, $1 to $3 an issue.

Correspondence, views and opinions on all topics within the province of this journal are cordially invited from any part of the world. We will thank readers to forward to us—**promptly** as they occur—**Items of News,** or information relating to any application of electricity, also marked copies of their local papers containing anything likely to interest electricians. Anonymous communications cannot be noticed, nor can rejected manuscript be returned, unless accompanied by the necessary postage when received.

Matter for the **Editorial** Department should be addressed to
The Editor of The Electrical World, New York.

Subscriptions and communications relating to **Advertising** or the **Business Department** should be addressed to
W. J. JOHNSTON, Publisher,
Potter Building, New York.
OR ANY OF THE BRANCH OFFICES.

CONTENTS.

ILLUSTRATED ARTICLES:	PAGE.
On the Size of Conductors for Incandescent Lighting when Lamps are in Multiple Arc	36
Reckenzaun's Electric Mining Locomotive	37
The Gulcher Electric Light	37
A Self-Winding Clock	38
Award of the New York Electrical Subway Contract	39
EDITORIAL PARAGRAPHS	35
MISCELLANEOUS:	
The Case Method of Converting Heat into Electrical Energy	36
Ozone by Electrolysis	36
Some New Results in Thermo-Electricity	37
Telephonic Conversations admissible as Evidence	37
The Proposed Canada-Australian Cable	37
MISCELLANEOUS:	PAGE
An Impalpable Counter	38
Electrolytic Treatment of Argentiferous Zinc	38
Variations in Bell Telephone Stock	38
Insurance of Electric Light Stations	38
DEPARTMENTS:	
New York Notes	44
New England Notes	44
Western Notes	44
The Telegraph	45
The Telephone	45
The Electric Light	45
Applications of Power	45
Personals	45
Miscellaneous Notes	45
Stock Quotations	45
Business Notices	45
Our Illustrated Record of Electrical Patents	46

New Advertisements.

	PAGE.
The Gamewell Fire Alarm Telegraph Co.—Fire Alarm and Police Telegraph System	46
F. G Robinson—Contractor for Electrical Work	46
Vandepoele Electric Manufacturing Co.—Arc Light Dynamos and Lamps, Electric Motors and Electric Railwey Apparatus	vii
Kensington Engine Works—The "Buckeye Automatic" Engine	viii
Partz Electric Battery Co.—New Voltaic Batteries	viii
New York Safety Steam Power Co.—Engines of all Sizes for Electric Lighting	viii
Bishop Gutta-Percha Works—Aerial, Underground and Submarine Cables	ix
Chemical Electric Light & Power Co.—Volta Pavia Test	ix
Synchronous Time Co	ix
Link Belt Machinery Co.—Hub Friction Clutch Pulley	ix
Sperry Electric Light Motor & Car Brake Co	xi

Vol. VIII. NEW YORK, JULY 24, 1886. No. 4.

THE late strike of operators at Omaha has stood alone as an exhibition of discontent on the part of the employés of the Western Union Company. While dissatisfaction is by no means limited to Omaha, the operators have everywhere else exercised self-restraint and judgment. It is a pity that the differences in Omaha could not have been amicably adjusted.

OUR Western representative furnishes some interesting matter this week as to the progress made in the West by the incandescent light, and gives the figures of duration obtained from incandescent lamps in various situations. He notes, too, the significant fact that the branch Edison Company, operating from Chicago, finds a very brisk demand for the Sprague motor.

AS WE anticipated, the steps taken toward putting the wires underground in New York have greatly stimulated the discussion of the topic of underground wires in other cities. Our exchanges bear ample evidence that the example of New York is having the effect that we thought it would. It should be noted that the Brooklyn Board of Subway Commissioners is busily engaged carrying out its plans, and, as its acts are all done in good faith, is enjoying the cordial co-operation of the companies concerned.

THE recent advance of Bell telephone stock in spite of the impending government suit to break the patent, is striking, and yet it has good warrant. The American Bell Company is conservatively managed, has large earnings and is engaged in a business that must grow. There are to-day, too, many departments in which the telephone could be used with profit, to say nothing of the long-distance business. It is not particularly to the interest of the company to cultivate those fields just now, but the fertile soil is there, nevertheless, ready to yield rich harvests when the right time comes. Hence the real value of the stock through all vicissitudes of the market.

ACCORDING to latest advices from England, the "cable pool" directors find an increase of 110 per cent. in their business since the late cut was made in rates. They now say that low rates had never had a fair test before, and that they propose to go on at the existing tariff for as long as five years, when a paying traffic will have been developed. We do not believe that the directors contemplate going five years or even five months longer at the present low prices, but the increase in business is certainly an indication that if encouraged, the mercantile community and the newspapers will use the cables more and more, so that in the long run there will be fair profit in moderate charges. The pool directors are "bluffing."

WE publish in another column the circular that has just been issued to the electric light companies in the Atlantic States canvassing their views on the mutual insurance of their stations. The result of the inquiry will be watched with great interest. The whole success of any such plan depends upon the development of the fact that there is enough of this property, of good quality, from the underwriter's standpoint, to render proper and feasible the formation of such a company. Those best qualified to form an opinion on the subject are understood to have implicit faith in the ultimate success of the plan; and the rapid increase in the number and value of electric light plants will soon meet the conditions necessary to the realization of the ideas of the promoters. We look forward, indeed, to some definite work being done in this respect at the Detroit meeting.

THE new telephone, called "krotophone," which has just been patented, is a most curious adaptation of a principle for the reproduction of articulate speech. The action, according to the inventor, seems to be one of the polarization of the molecules of the conducting material, and sounds are produced thereby due to the changing position of molecules upon the passage of the current. This forcibly reminds us of the "sound of magnetization" observed by Page, who noted a click upon the alternate magnetization and demagnetization of an iron bar. It recalls also the first form of telephone receiver designed by Reis—the "knitting needle"—in which this principle is applied. It would seem that in the krotophone the intermediate work of magnetism is done away with, and the electric current is used directly as the polarizing and sound-producing force.

WE give this week some additional particulars regarding the new form of electrical generator devised by Mr. W. E. Case, of Auburn, N. Y. As this form of generator will probably enjoy some prominence in the future, it may be well, in order to avoid periphrase, to designate it by a specific term. We should select the expression "heat cell," as, to our minds, the most appropriate, and in conformity to precedent in the case of the selenium, or "light cell," in which the name of the inducing force is also employed as the denominator. So far as the durability of the cell is concerned, the testimony cited in another column is highly favorable. But it will be noted that the E. M. F. of the cell is comparatively low, being at its best hardly one-fourth that of the Daniell. Still, as compared with the E. M. F. of thermopile combinations, this is a great step in advance. There is, perhaps, much to be learnt of this new form of generator, and we hope to see its study prosecuted with vigor.

WHEN the great iron tower, 1,000 feet high, was proposed some time ago for the Paris exhibition of 1889, many engineers doubted the feasibility of the project, judged from their point of view. However, M. Eiffel went at the problem and evolved a design which was chosen and which it is proposed to execute. On the eve of accomplishment, however, a French "savant" comes forward with a timely warning of the fearful consequences which the building of the iron tower will entail. He says that the enormous blocks of iron running north and south would become polarized, and that this polarization will soon invade the whole column. Then who knows whether the four lifts with their continual friction will not increase the magnetic influence a hundredfold? In this case all articles for a mile round will be attracted to the tower, and will adhere to it as a needle does to a magnet. If the troops quartered in the Ecole Militaire hard by be called out to drill, it will be all in vain for the commanding officer to shout "En avant!" if they are paraded with the column behind them. Then all the houses in Paris will suffer from a St. Vitus' dance, and, being gradually drawn toward the Champ de Mars, will finally find themselves stuck to the tower. As for locomotives entering Paris it will be found impossible to stop them at the various termini; they will rush through the city and dash themselves to pieces against the centre of attraction. These and other evils, we are told, will follow the erection of the great Eiffel tower, which might, indeed, be called the Teufel tower.

THE frequency with which we are applied to for information regarding the proper size of conductors shows that a lively interest is taken in all that pertains to the distribution of electricity. The success of incandescent lighting especially depends in a great measure upon the proportions of the conductors, and this becomes more manifest as the extent of the area over which the lamps are spread is increased. We then have to make allowance for loss of potential due to the resistance of conductors if we wish to keep the lamps at uniform brilliancy, and this problem of maintaining uniform brilliancy of lamps in all parts of the circuit has called into existence a number of methods of distribution and disposition of conductors. In this issue Mr. H. Ward Leonard gives the results of his extended experience in the proportioning of the size of wires for incandescent lighting, and the formulas he submits are quite simple compared with some others we have seen. Mr. Leonard gives two formulas by which the size of conductors can be determined, and either can be applied as desired. We may remark that in this country the size of conductors is usually determined by the loss in or fall of potential, due to the resistance of the conductor, and the first formula of Mr. Leonard applies to this case. Abroad, however, to a great extent, the size of electric-light conductors is calculated by taking as a basis the current which they are required to transmit. Both methods give good results when intelligently applied; but where the question is one of the wiring of a constant potential circuit, as in incandescent lighting, it would appear to be preferable to base the calculations upon the allowable loss or fall of potential in the conductor; for it is evident that, while the size of a conductor might be ample to transmit sufficient current to a lamp, its length, and hence the ratio of its resistance to that of the lamp itself, is not included in the calculation. It is frequently desirable to calculate the size of conductors necessary for the safe transmission of currents and in such cases the second formula and accompanying table and diagram will be found very useful.

IN our pages this week will be found a very full record of the steps taken by the New York Electrical Subway Commission in awarding to a construction company the contract for carrying out underground work under the supervision of the commission and its officers. The importance of the subject demands that it should receive the closest attention, now that serious, earnest and practical work is begun, and we have therefore devoted much of our space to it. We are glad also to be able to be the first in making public the designs that Mr. John Thomson has with great care and skill prepared at the direction of the commission for its guidance in the undertaking. At this stage it is not unfitting to express our opinion that Mr. Flower and his associates are making a solid reputation for themselves by the way in which they are pushing on the work. It is natural that they who have been disappointed by failing to secure the contract should feel sore and even suspicious, but they must know that had they been successful they, too, would have been like objects of envy to the unsuccessful competitors. No one can allege that the construction company is not strong in every respect. There are whispers that it has alliance with the telephone interests in this city. That may be so, but such an alliance only implies that the company holding perhaps the largest stake in wire mileage, actual and prospective, has very reasonably desired not to imperil its property by leaving it to chance and unfriendly control. Provided the commission makes the construction company live up to the contract, Mr. Jay Gould or Mr. Edward Stokes, or Mr. Bennett, or Mr. George Jones might own the whole stock without any harm to users of the conduits. The key of the position, in fact, is the commission rather than the construction company, and as the commission is the creation of the Legislature, the control is after all in the hands of the people. While we feel by no means sure that the commission will always be a body pleasing to the electrical companies generally, or worthy of confidence, it does look as though it will give satisfaction as at present constituted. It being evidently the wish of the public to have the wires buried, Mr. Flower bids fair to be as popular and successful a master of effodient ceremonies as one could ask for; and while there need be and will be no suspension of watchfulness or of criticism, there should be a willingness to give credit for honesty of purpose until something is proved to the contrary. Mr. Flower's public career is, to put the matter on the lowest platform of ethics or ambition, not yet so far accomplished that he is likely to sacrifice any share of public good will in so small a matter relatively as putting the electric wires of New York out of sight.

The Case Method of Converting Heat into Electrical Energy.

The ingenious "heat cell"—if we may be allowed to coin a new term—which we described last week, by which galvanic action is obtained through the medium of heat, has attracted considerable attention, and Dr. Park Benjamin has kindly furnished us with additional particulars regarding it. Mr. W. H. Preece, the well-known electrician, recently presented a paper to the Royal Society describing the battery, in which it was shown that the action upon which it was based in part was due to an experiment of M. Henri Loewel (see *The Chemist*, Part VIII., p. 476), who showed that the addition of a solution of chromous chloride to stannous chloride caused a precipitate of metallic tin, the reaction forming chromic chloride.

On heating the solution to the boiling point, 212° Fahr., it was found the precipitated metal was in a great measure redissolved, forming the original solution, chromous chloride and stannous chloride, without the liberation of hydrogen.

On cooling this solution the tin was again precipitated, the action continuing as often as the solution was heated and cooled.

As chromous chloride has a great affinity for oxygen, it is necessary the air should be excluded from the solution, otherwise the chromous chloride would be reduced to oxychloride of chrome, as Loewel states, and the reactions would cease to take place after a time, the stannous chloride formed during each heating remaining in solution.

Mr. W. E. Case constructed, in the form of a simple galvanic cell, a small element with the solution, chromic chloride, as the electrolyte, using tin as the positive and platinum as the negative metal.

At 60° F. this element gives no electromotive force, although in this case, when the cell was first set up, it gave 0.0048 volt, owing probably to the presence of some foreign substance.

On the application of heat the E. M. F. rose and fell somewhat irregularly, due probably to unequal heating.

At the termination of the experiment, when the cell had cooled down to 60° F., no electromotive force was observed.

The highest electromotive force was 0.2607 volt at 197° F., the highest degree to which the temperature was raised.

When the temperature of this element was lowered to about 145° F., the reactions before mentioned took place.

The tin taken up by the solution during heating commenced to precipitate, increasing as the temperature lowered, and the metal fell to the bottom of the cell in a form to be again utilized in the generation of the current.

The amount of local action or chemical corrosion which took place about 150° F. was excessive, but the metal taken up by the solution was very much less when the temperature of the electrolyte was not raised above the point of precipitation, 140° F.

The metal taken up below this point appears to be precipitated under the same conditions as that taken up at higher temperature, and seems to be precipitated whether the circuit be open or closed.

Regarding the life of these cells, Dr. Benjamin informs us that he has had one of them in his office from February, 1885, up to a very recent date, for a period of fifteen months, during which time he caused it to yield its current and regenerate scores of times; and at the end, when it was broken up for examination, no difference in its internal constitution could be detected.

On the Size of Conductors for Incandescent Lighting when Lamps are in Multiple Arc.

BY H. WARD LEONARD.

1. SIZE AS DETERMINED BY A REQUIRED LOSS OF ELECTROMOTIVE FORCE IN THE CONDUCTOR.

In the various electrical text-books and journals there is a great dearth of practical information upon this subject. In the principal companies engaged in installing incandescent lamps, most of the employés use formulas for the determination of the circular millage of a wire which depend directly upon the resistance of the lamp and upon some percentage of loss of the total available electromotive force, and which involve the use of a "table of constants," a different constant being required for each candle-power of lamps of the same electromotive force and having the same economy, and also for each variation in electromotive force in lamps of the same candle-power.

The writer, after deriving and using quite a number of different formulas which were steps toward increased simplicity and accuracy, last year derived the formula given below, and its use by himself and others associated with him has been so satisfactory, that he has been led to hope that it may be of assistance to some who are at present inconvenienced by the necessity of a "table of constants" which are worthless in case of a variation of candle-power or economy of the lamps they apply to.

Let E = E. M. F. required to bring the lamps to nominal candle-power.

C = the current required by lamps in ampères.

$C.\ P.$ = the aggregate candle-power of the lamps.

$C.\ H.\ P.$ = the economy of lamps expressed in candles per electrical horse-power.

V = the loss of E. M. F. in the conductor both ways, expressed in volts.

D = the distance to the lamps expressed in feet.

M = the number of circular mils of the wire.

R = the resistance of the wire both ways.

Since 1 watt = 44.24 ft.-lbs per minute, we have:

$E \times C \times 44.24$ = the ft.-lbs. per minute absorbed by the lamps.

Now, evidently, $$\frac{E \times C \times 44.24}{33000} = \frac{C.\ P.}{C.\ H.\ P.}$$

$$\therefore C = \frac{33000 \times C.\ P.}{E \times 44.24 \times C.\ H.\ P.} \qquad (1)$$

Now, the resistance of 1 ft. circular mil of copper of 96 per cent. conductivity = 10.725 ohms.

$$\therefore R = \frac{10.725 \times 2\,D}{M}$$

By Ohm's law, $$C = \frac{V}{R}$$

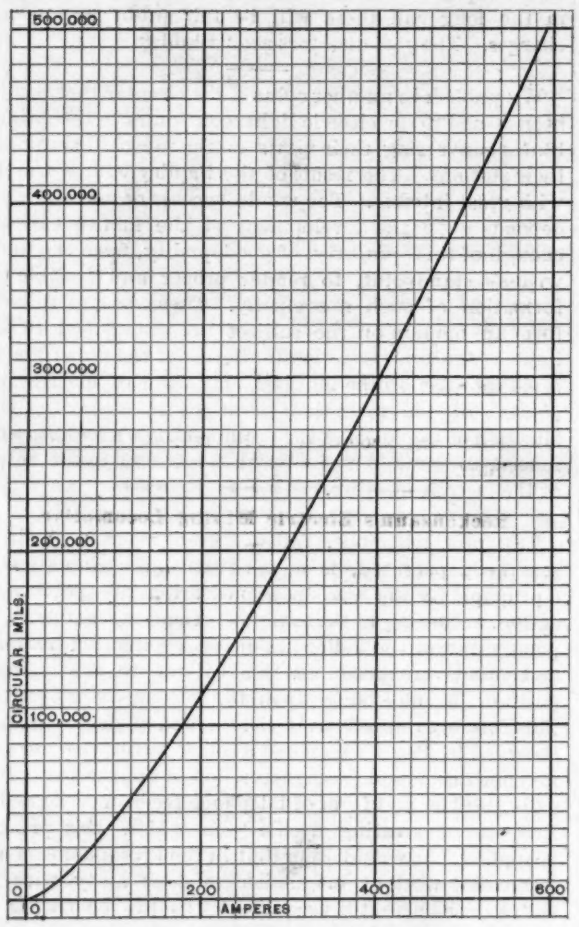
$$\therefore C = \frac{M\,V}{10.725 \times 2\,D} \qquad (2)$$

Now, by (1) and (2) we have:

$$\frac{M\,V}{10.725 \times 2\,D} = \frac{33000 \times C.\ P.}{E \times 44.24 \times C.\ H.\ P.}$$

Whence $$M = \frac{D \times C.\ P.}{V \times E \times C.\ H.\ P.} \times 16000.$$

By the substitution of the economy in candles per horse-power, we have a formula of extreme simplicity, with but



CURVE OF MAXIMUM SAFE CURRENT FOR BARE COPPER WIRE.

one constant for lamps of one economy, no matter what the variations of candle-power and the electromotive force required may be.

For example, in the case of Edison lamps, which have an economy of 160 candles to the electrical horse-power, the formula becomes:

$$M = \frac{C.\ P. \times D \times 100}{V \times E}$$

And it will be noticed that in the case of lamps of 100 volts, which are largely used in this system, the constant vanishes, and the formula becomes:

$$M = \frac{C.\ P. \times D}{V}$$

which, for simplicity, it would be difficult to excel.

From the results of the Franklin Institute test, the constants for the various lamps are given in the table below; as the candle-power of the various lamps was not the same, the mean spherical candle-power is also given:

Name.	Description. Volts.	Sp. candles per el. h.-p.	Mean sp. candles.	K.	Relative size of conductor required.
Edison	99	169	15.47	95	45
Stanley	96	189	13.59	85	41
"	44	216	13.42	74	78
Woodhouse & Rawson (2d lot.)	55	210	15.64	76	64
		210	18.30	76	64
White	50	183	12.44	87	80
Weston, tamadine	110.5	210	16.43	76	32
" paper	70	166	15.18	100	63

2. ON THE SIZE OF CONDUCTORS AS DETERMINED BY THE HEATING DUE TO THE CURRENT.

Let D = diameter of wire in mils.

M = number of circular mils of wire (area of cross-section).

C = current in ampères.

R = resistance of unit length of wire.

K = a constant.

The surface of wire of unit length = πD.

Heat radiated varies directly as πD.

Heat generated varies directly as $C^2 R$.

Now, R varies inversely as M.

Therefore, the heat generated varies as $\frac{C^2}{M}$; or, the heat generated $= \frac{C^2}{M} \times$ constant.

Similarly, heat radiated $= \pi D \times$ const.; and since $D = \sqrt{M}$, we have heat radiated $= \sqrt{M} \times$ const.

Now, since when the temperature of the wire is constant the heat generated will equal the heat radiated, we have:

$$\frac{C^2 \times \text{const.}}{M} = \sqrt{M} \times \text{const.}$$

$$\therefore M^3 = C^4 \times K$$

$$\therefore M = C^{\frac{4}{3}} \times K$$

and $$C = \frac{M^{\frac{3}{4}}}{K^{\frac{1}{4}}}$$

In practice, the only wires of a system of conductors for incandescent lighting which we need expect excessive heating in are the so-called "omnibus" wires, which carry the total current, and possibly the feeders, which also carry heavy currents.

The results of some experiments on bright bare copper wire gave the value 100 for K in the above formula when the temperature of the wire was raised 81 deg. F., or 45 deg. C. That is, for such a rise of temperature as that mentioned, the formula becomes

$$M = C^{\frac{4}{3}} \times 100$$

and $$C = M^{\frac{3}{4}} \times .0316$$

The above formula is applicable to cases when bare or insulated (which latter will be at somewhat lower temperature) wire is to be used and is to have free access to air.

Below are given the data, derived from the use of this formula, as regards the size of wire for various currents, and a curve plotted from the table is also given:

Gauge number B. W. G.	Sectional area in Circ. mils.	Safe current in ampères.	Circ. mils per ampère.
.....	500,000	595	822
.....	400,000	503	795
.....	300,000	405	740
.....	250,000	354	707
0000	206,116	306	674
000	180,625	278	652
00	144,400	234	616
0	115,600	199	584
1	90,000	164	548
2	80,656	151	533
3	67,081	132	509
4	56,644	116	488
5	48,400	103	469
6	41,209	92	451
7	32,400	76	424
8	27,225	67	406
9	21,904	57	385
10	17,956	49	366
11	14,400	42	346
12	11,881	36	330
13	9,025	29	309
14	6,889	24	288
15	5,184	19	268
16	4,225	17	255
17	3,364	14	241
18	2,401	11	221

In the case of armatures, 60 deg. C. is about the maximum safe rise of temperature admissible.

For armatures of the Siemens and similar types, the constant for 60 deg. C. rise is 140; that is, the formula becomes:

$$M = C^{\frac{4}{3}} \times 140,$$

and $$C = M^{\frac{3}{4}} \times .02457.$$

Ozone by Electrolysis.

At the last meeting of the Chemical Society a paper was read by Prof. H. McLeod, F.R.S., on "The Electrolysis of Aqueous Solutions of Sulphuric Acid, with Special Reference to the Forms of Oxygen Obtained," of which the following is an abstract:—"The experiments were instituted to determine the quantity of ozone that can be obtained by electrolysis. The negative electrode consisted of a small platinum plate, and the positive of a tube containing mercury and with fine platinum wires of 0.45 mm. and 0.027 mm. in diameter fused into the glass. Several wires were used, the total length being about 6 mm. The electrolysis was carried out in a U-tube surrounded by ice and water; the hydrogen was collected over water, and the ozonized oxygen passed through a tube containing a solution of potassic iodide, the oxygen being afterwards collected. The quantity of ozone was determined by acidifying the potassic iodide solution and decolorizing by a standard solution of sodic thiosulphate. In the electrolyzed acid an oxidizing substance is present which is not hydroxyl, but is probably Berthelot's persulphuric acid. The amount of this 'active oxygen' was found by adding potassic iodide to the liquid and decolorizing by the solution of thiosulphate. The electric current was measured by a tangent galvanometer, and the dimensions of the wires of the positive pole were determined; from these data the intensity of the current was calculated. Acids were used of relative densi-

ties varying between 1.025 and 1.7. The maximum quantity of ozone was obtained with solutions about 1.075 or 1.1 in density, the electrolytic oxygen containing about 16 or 17 per cent. of its weight of ozone. The maximum quantity of 'active oxygen' in the oxidizing substance referred to was produced with acids about 1.2 to 1.25 in density, the proportion being 16 or 17 atoms to 100 atoms of hydrogen."

Some New Results in Thermo-Electricity.

At a recent meeting of the Physical Science Section of the Dundee Naturalists' Society, Prof. Ewing gave an account of "some new results in thermo-electricity," which had been arrived at in the course of a long series of experiments which he had conducted in the laboratory of the University of Tokio, Japan. The researches referred to the effect of stress, and also of magnetization on the thermo-electric quality of iron. When an iron wire, supported at one end, was loaded by applying weights to the other end, its magnetic and thermo-electric qualities underwent a very remarkable series of changes as the loads were alternately applied and removed, and in both cases the changes of quality lagged behind the changes of load, no matter how slowly these were performed. Prof. Ewing had found it desirable to give a name to this peculiar action, and for that purpose he had devised the word "hysteresis," the use of which he suggested. The paper described some of the more singular manifestations of this physical peculiarity of iron, and concluded with a speculation as to the kind of molecular structure which might exist in iron so as to give rise to the effect noted.

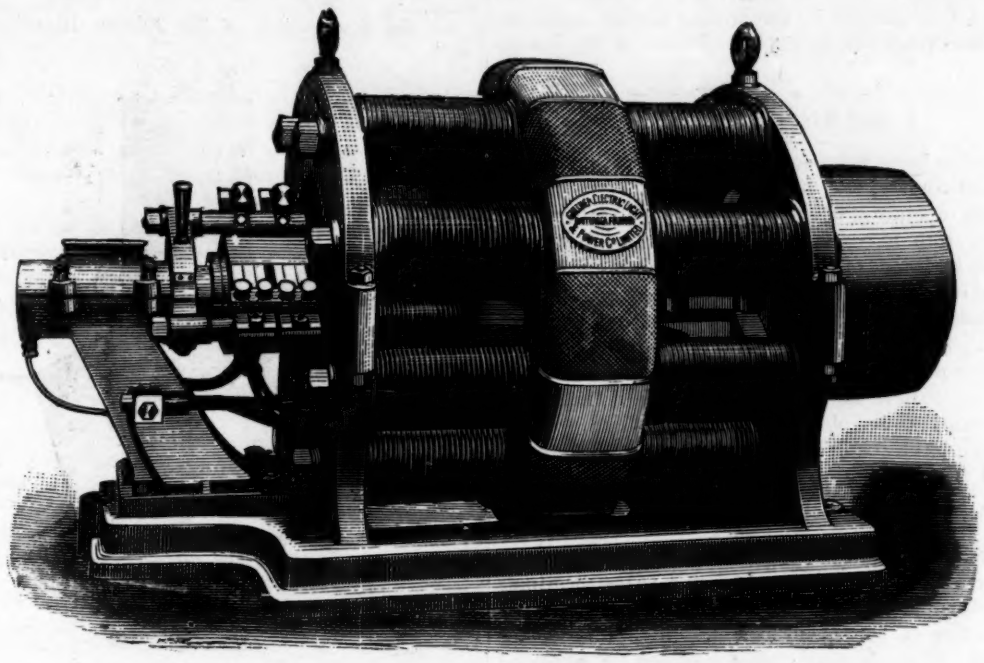


FIG. 1.—GULCHER SYSTEM—DYNAMO.

Telephonic Conversations Admissible as Evidence.

As already noted briefly in these columns, Judge Barclay, at St. Louis, on July 8, rendered a favorable opinion on the admissibility of telephonic conversations as evidence. In the case of the Globe Printing Company vs. Stahl, on a motion for a new trial, he says:

"This case directly presents the question of the admissibility in evidence of certain business conversations through the telephone.

"At the trial it was proven that one of the plaintiff's agents had a conversation concerning the matter in controversy here with defendant personally through the telephone in the usual manner. This witness testified that he recognized defendant's voice, which he knew, and as to the admissibility of that conversation defendant had raised no objection. The difficulty relates to the testimony of another witness, who stated that he didn't know defendant's voice or those of his clerks, and who was brought into communication with defendant solely through the telephone. He stated that he 'rang up' the defendant's number on the telephone list, and after being duly connected by the central office, he asked: 'Is this Stahl?' (the defendant). The answer was, 'Yes!' He then had some conversation with the answering party, which defendant urgently objected to as incompetent on the ground that there was no satisfactory evidence of identity of the party answering. At the trial the court admitted the evidence, and on this motion for a new trial the court has been asked to review the ruling, and has done so with some care.

"The courts of justice cannot and do not desire to ignore the great changes in modes of intercommunication which the introduction of the telegraph and telephone have accomplished. It is certainly the duty of courts to take judicial notice of such facts of general scientific knowledge as are part of public contemporary history. [78 Mo., 318.] The nature, operation and ordinary uses of the telephone are such facts, and the courts should accordingly take such notice of them. When a person places himself in connection with the telephone system by having a telephone in his business office, he thereby invites communication in relation to his business through that medium. Such conversations, so held, are as admissible as personal conversations by a business customer with an unknown clerk in charge of an ordering business office would be. The fact that the voice at defendant's telephone was not identified as that of defendant or any of his clerks does not render the communication inadmissible.

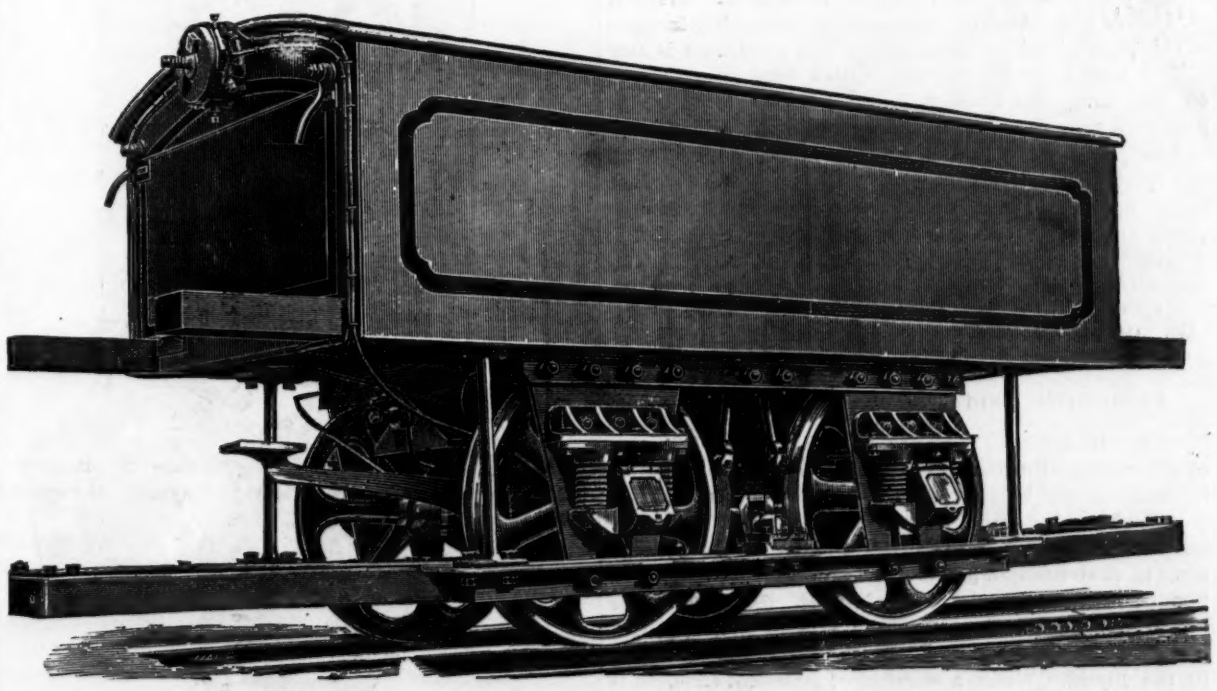
"The ruling here announced is intended to relate merely to the question of admissibility in evidence of such conversations in such circumstances, but not to determine the effect of such evidence after it is admitted. It may be entitled, in each instance, to much or little weight in the estimation of the triers of facts, according to the view taken by them of it and of the other testimony in support, or in denial or contradiction thereof.

"After some deliberation, therefore, the court is of opinion that the ruling made on this question at the trial was correct, and accordingly the motion for a new trial is overruled."

Reckenzaun's Electric Mining Locomotive.

In our issue of May 22 we gave the results of a series of tests made upon the motors for the electric locomotive to be used in the Trafalgar collieries, England, and we are now enabled to illustrate the locomotive itself, which has been at work for some time. The locomotive carries its own store of current with it, consisting of a series of accumulators, the weight of which represents so much useful adhesive weight on the rails. Where the underground lines have sharp curves, haulage of trains by wire ropes presents great difficulties, and horses are generally employed. It is to be hoped that the practice will become obsolete now that it has been shown that an electric locomotive can successfully be employed. The construction of the motor and driving gear is similar to that adopted by the inventor in his electric street tramcars, but the conditions to be satisfied were widely different and more difficult than those obtaining in an ordinary tramway. The space is very limited, and since both sharp curves and heavy gradients occur at frequent intervals, it was somewhat difficult to stow away the necessary power in so limited a space. Within the narrow gauge of 2 ft. 7 in., and an extremely short wheel-base, there had to be arranged an electromotor of 8 horse-power, with suitable gearing, brakes, and attendant details. There is a footboard which runs all round the locomotive, and there is a brake lever at each end. The box forming the body of the car serves to receive the accumulators, and there is a compound switch at each end by which the motor can be started, stopped, and reversed by the attendant who stands at one end or the other of the footboard, according to the direction in which the locomotive is traveling. The switches are inclosed in a box to protect them from accidental injury.

We are indebted to our contemporary, *Industries*, for the accompanying illustration.



THE RECKENZAUN MINING ELECTRIC LOCOMOTIVE.

The Proposed Canada-Australian Cable.

A special dispatch from Ottawa, of July 14, says: Sanford Fleming, one of the best civil engineers in Canada, sailed for England to-day on behalf of the Canadian Pacific Railway, to confer with the Imperial Government and the Australian Agent-General concerning the establishment of cable communication between Canada, Japan and Australia, and to ascertain the amount of the annual subsidy which other colonies will guarantee. Sir Charles Tupper will also receive instructions from the Dominion Government. This is Mr. Fleming's scheme, and the Imperial authorities promise to support it: The idea is to lay a cable from Victoria, B. C., thence either to the Aleutian or Sandwich Islands; thence to Yeddo, Japan; thence to Hong Kong, and from there to Australia. It is understood here that the cable is to be laid and connected with the Canadian Pacific Railway telegraph system.

The matter has been under the consideration of the colonial agents, and a dispatch from London, of July 15, says: At several meetings of the colonial agents which have been held recently, the project of connecting the Dominion of Canada and Australia by cables has been generally discussed. The South Australian agents are steadily declining to join in any scheme for the accomplishment of this object, claiming it would be certain to injure the interests of the Australian overland line of telegraph.

The Gulcher Electric Light.

The Gülcher Electric Light and Power Company have recently completed one of the largest installations carried out in Yorkshire, Eng. The light has been adopted in the finishing department of Messrs. Jonas Brooks & Brothers, of Meltham Mills, and the following is the arrangement of the lamps: No. 1 room, black finishing, winding, and beaming department, 140 lamps, 20 candle-powder; No. 2, white ditto, 71 lamps, 20 candle-power; No. 3, 36 lamps, 20 candle-powder; No. 4, 4 lamps, 20 candle-power; No. 5, 3 lamps, 20 candle-power; No. 6, 4 lamps, 20 candle-power; engineer's room, 1 lamp, 20 candle-power; stores, 1 lamp, 20 candle-power; total, 260.

The 260 lamps in this installation are of the Swan-Edison 90-volt type, and are driven from a No. 5 Gülcher compound wound dynamo, of their latest and most improved type, shown in Fig. 1. The machine is capable of giving a current of 220 ampères at 100 volts E. M. F., or an electrical output of 22,000 watts at a speed of 500 revolutions per minute. It is thus large enough to allow of the installation being extended, should additional lights be required.

The current from the dynamo is led by cables neatly cased into three main switches and cut-outs, each fitted in a box with lock and key. The current is then split into three circuits, one of 140 lamps, one of 84 lamps, and one of 36 lamps, and led to the different departments. The lamps are tapped off the mains in circuits of five;

each small circuit is fitted with a switch and cut out, enabling any portion of the installation to be switched on or off, as occasion offers.

The lamps themselves are all suspended from the ceiling by means of long wrought-iron pendants, and in order that the utmost efficiency may be obtained each lamp is fitted with an opal reflector 6 in. in diameter.

The same firm have also introduced the Gülcher arc light into their dye houses, and Fig. 3 shows the factory

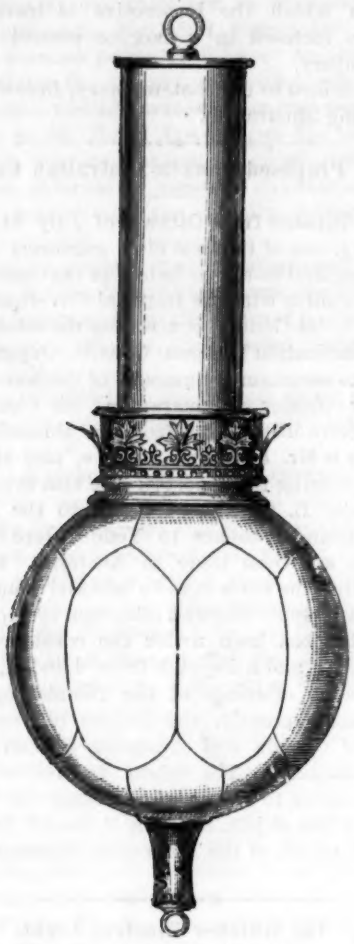


FIG. 2.—GULCHER ARC LAMP.

lamp employed, Fig. 2 being that used for ornamental purposes.

An Impalpable Counter.

An ingenious method of indicating the oscillations of a free pendulum, and which, indeed, is applicable to other delicate movements which require to be unhampered by extraneous forces, has been devised by M. Marcel Deprez, the well-known French electrician. M. d'Abbadie, of the French Academy of Sciences, proposed to utilize a ray of light incident at each oscillation on a selenium cell in circuit with a battery and an electro-magnetic counter. M. Deprez has, however, chosen a thermo-electric in place of this photophonic arrangement. The pendulum is furnished with a screen provided with a window 30 mm. to 40 mm. long and 3 mm. to 4 mm. wide. A pencil of luminous rays from a petroleum lamp with a flat wick and concentrated by means of a cylindrical lens traversing the aperture or window at each oscillation, is caused to strike upon a thermo-electric pile having all its like junctions echeloned on a length equal to that of the window. At each oscillation an electric current is thus sent through the galvanometer, which is very sensitive and aperiodic. This galvanometer works a relay which closes the circuit of an electric counter.

Electrolytic Treatment of Argentiferous Zinc.

At Friedrichshütte, in Silesia, the following modification of the treatment of the zinc, lead and silver alloy obtained in desilverizing lead by Parkes' process has been introduced. The zinc skimmings, averaging lead 90, zinc 8-10, and silver 0.5-2.0 per cent., are granulated and placed in a layer at the bottom of a lead-lined tub filled with a solution of sulphate of zinc, forming the electrolyte. The positive electrode is formed by the lead plate at the bottom, while the cathode is a zinc plate suspended vertically in the liquid. When a current of sufficient strength is passed through the apparatus, zinc is deposited on the cathode, a corresponding quantity of the metal being dissolved from the granulated alloy, so that the strength of the solution is kept approximately constant. The decomposition goes on until the residual alloy, which may be about one-half of the regular quantity, is protected by the excess of lead from further action, when it is washed, dried, and subjected to liquation. By the latter operation lead is separated of sufficient purity to be passed at once to the refinery, while the residue contains zinc and lead in about the same proportion as the original zinc-skimmings, and is of the same fine-grained character. This is subjected to the electrolytic process a second time, followed by subsequent liquation. By these alternate operations, zinc, lead and silver are obtained in the metallic state, instead of the mixed oxides of lead and zinc formerly produced in considerable quantity, which could only be made marketable with difficulty.

Variations in Bell Telephone Stock.

Owing to prospects—rumored—of extra dividends and subscription rights on long-distance telephone stock, Bell stock has been very active and bullish of late, reaching 225 on Saturday last. The subjoined table shows the fluctuations of the stock since 1884:

	1884-85.		1885-86.	
	High.	Low.	High.	Low.
July	156	149½	206	195
August	165	157	207	198
September	173	154	199½	178
October	195	166½	183⅛	175
November	220	185½	177	160
December	275	253	178⅛	165
January	253	210	178	155
February	228½	215½	168	144½
March	224	215	161	147
April	222	195	165	156
May	203	173	174	155
June	213	175	188½	174½

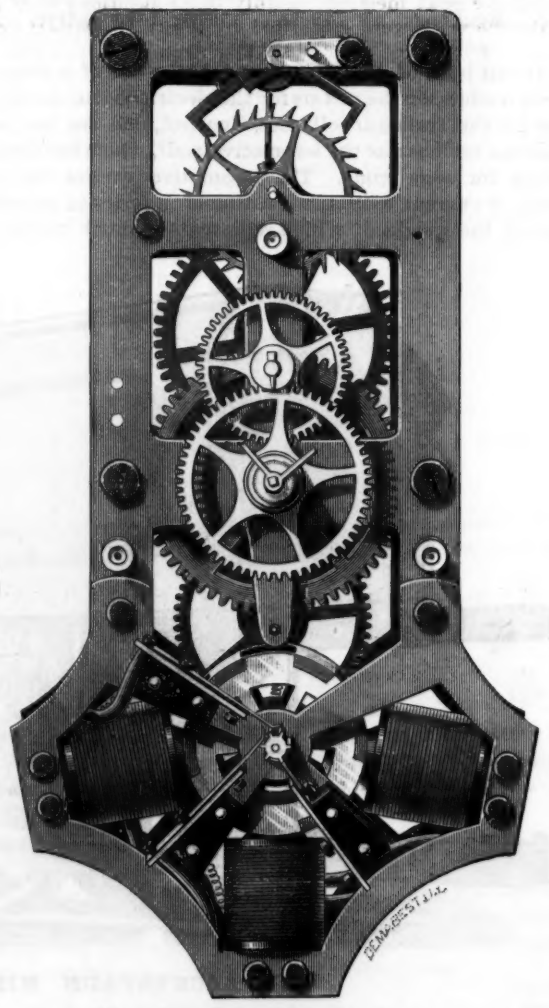
The above does not include the present period, when the range has been from 185½ to 225, a variation of 39½ points in a fortnight.

A Self-Winding Clock.

Many devices have been employed for operating clocks to keep them correct, and in the majority of cases the impulse for the revolution of the hands has been transmitted electrically from a central point. Recently, however, Mr. Chester H. Pond, of this city, has devised an ingenious method of maintaining accurate time, which makes the clock independent of all extraneous influences in its movement. This is accomplished by the addition of a small electric motor geared to the winding train, which is set in operation automatically at fixed intervals. Several advantages are obtained by this method, for not only does the clock require no winding by hand, but the element of frequent and regular winding also shortens the "train" and greatly decreases the friction and strain upon it.

The mechanism which is shown in the accompanying engraving embraces a small electric motor, to the terminals of which two small open-circuit cells are connected. At each revolution of the spring-barrel, which takes place once every hour, the battery circuit is closed for a period of about six seconds, During this time the motor revolves and winds the spring, which is a very light one, having a tension of only 3½ oz. At the end of this short period the circuit is automatically broken and the motor stops.

By this means the clock is wound to the same tension



WORKS OF SELF-WINDING CLOCK.

every hour, and as the spring is wound in the same direction in which the train moves, no "maintaining power" is required in the clock, as would otherwise be necessary.

The action required of the battery is so slight that it operates without renewal for more than a year.

These clocks, which are made by Messrs. C. H. Pond & Co., of this city, when accurately regulated maintain, it is claimed, remarkably accurate time, as was demonstrated by a recent test made under the direction of the Meteorological Society. Where it is required to maintain absolute standard time, these clocks are provided with an arrangement in circuit with a standard clock, and an impulse sent out at intervals of 24 hours brings the hands to indicate absolutely correct time if they should happen to vary.

Insurance of Electric Light Stations.

The discussion of the insurance of electric light stations on the mutual plan, started some months ago by Mr. F. A Gilbert and Mr. J. English, promises to result in something tangible and practical. The present situation is defined in a circular issued last week by those interested in the movement and sent to electric lighting stations in New England, New York, New Jersey, Pennsylvania, Delaware and Maryland. It reads as follows:

At the meeting of the National Electric Light Association in Baltimore, last February, the question of the organization of an Electric Mutual Insurance Company, for the Insurance of Electric Lighting Stations, and perhaps kindred industries, received a full discussion, and the following resolution was adopted:

"*Resolved*, That the Association indorses the plan of an organization of a Mutual Electric Light Insurance Company."

At the convention of the Edison Illuminating Com-

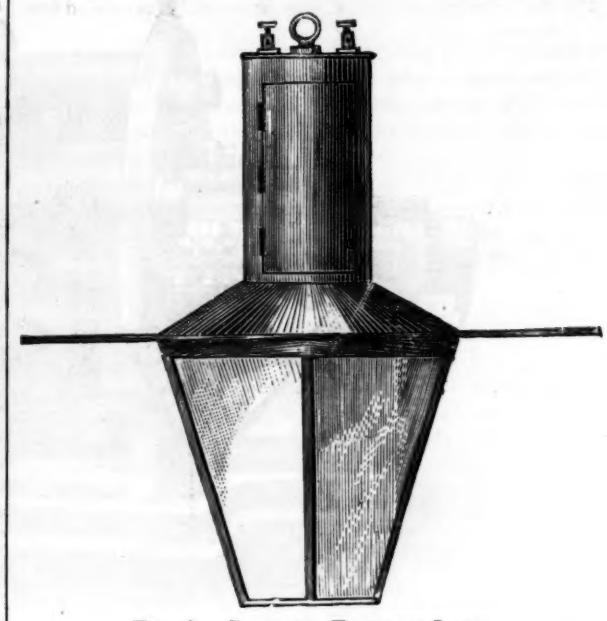


FIG. 3.—GULCHER FACTORY LAMP.

panies, held at Atlantic City, N. J., June 9, this matter was considered, and received general approval from the various local companies represented at the convention.

The proposition involves the formation of a mutual insurance company, managed by a board of directors, elected by the representatives of the property insured; that is, the electric interests form and control the company carrying their insurance, on the same basis as that followed by the Factory Mutual Insurance companies of New England, with great success for the past fifty years. These companies now insure over $400,000,000 upon industrial property in the New England States, New York, New Jersey, Pennsylvania, Delaware and Maryland.

Their policy has been conservative, always confining their insurance to first-class works, of good construction, and equipped with careful precautions against fire, both in regard to apparatus and care of the buildings. The result of this, as shown by the average of the annual reports of these companies, for the year 1885, has been that a class of manufacturing property ordinarily classed as hazardous, is insured at a cost of 15 cents on $100, or a little over one-seventh of one per cent. per annum.

Since the meeting of the National Electric Light Association this matter has received constant attention. Surveys have been made of a number of electric illuminating stations; by conference and correspondence it has been brought to the consideration of the leading parent companies, and by them heartily indorsed, as any reduction of the cost of insurance will conduce to the prosperity of the illuminating companies, by diminishing what is now a fixed charge in the production of light.

The organization of such a company cannot be undertaken, except on a sound and broadly conservative basis, such as can only be furnished by an amount of insurance ample enough to reduce the percentage of expense of administration to a small ratio of the premiums; and so widely distributed that it could not be disturbed by any unusual concentration of losses.

The cost of insurance in the proposed company will be the fire losses, and the expense of conducting the company, without any expense for commissions, advertising, or any of those items which are such a burden on the stock insurance business as carried on at the present day; and it is safe to assume that losses in a company controlled by the electric interests themselves would be adjusted in the most fair and equitable manner possible.

As it has not been feasible to visit all of the electric lighting stations in the district covered by the Factory Mutual Insurance Companies, which has been selected for a beginning, will you, at your earliest convenience, please fill out the inclosed blank, in order that a summary can be made and submitted, with a plan of operations, if advisable, at the next meeting of the National Electric Light Association.

The blank referred to asks for necessary information as to the nature and value of the plant, and as to the desire of the owning company to insure in a mutual company. It is to be returned to Mr. C. J. H. Woodbury, Boston, when filled up. The circular printed above is signed by F. A. Gilbert, vice-president of the Merchant's Company, of Boston; Hugh O'Brien, treasurer of the Brush Company, of Boston; A. Robeson, treasurer of the Weston Company, of Boston; Frank Ridlon, New England agent of the Brush-Swan Company; J. English, treasurer of the New Haven, Bridgeport and Newport companies, and W. L. Garrison, treasurer of the Edison Company, of Brockton, Mass.

Award of the New York Electrical Subway Contract.

On July 13, the Electrical Subway Commissioners, Flower, Moss and Hess, held a meeting, at which reports were presented by Mr. D. L. Gibbens, counsel, and Mr. J. Thomson, engineer. The report from Mr. Gibbens dealt with the right of the commission to make a contract with a construction company, and was accompanied by a form of contract. Both documents are given in full below. The report of Mr. Thomson dealt with the electrical and mechanical points involved. It is also given below, together with drawings made directly from the tracings prepared by Mr. Thomson for the commission. It will, of course, be seen that all the details have not been determined upon, but that very important steps have been taken toward early execution of the work. The commissioners then adopted the following resolutions:

Resolved, That the reports made this day by the engineers and counsel of this commission be laid upon the table for reference in providing for the details of the plan of the commission, as they are required to be provided for.

Resolved, That all currents of great intensity should be separated from all other currents, and that conductors of power and those used in arc lighting should be placed, wherever practical, in a conduit by themselves, subject to such regulations as may from time to time seem advisable to the commission.

Resolved, That currents of light intensity should be separated from all other currents, and that telegraph, telephone, ticker, messenger and fire-call wires and all those of that class may, wherever practical, be placed together in the same conduit, subject to such regulations as may from time to time seem advisable to the commission.

Resolved, That incandescent lighting wires should be provided for separately from all other wires, and be placed, wherever practical, in a conduit by themselves, subject to such regulations as may from time to time seem advisable to the commission.

Resolved, That the commission hereby invite all companies and persons in the city of New York using electrical conductors to submit estimates of the number and kind of conductors they will respectively require in an underground system in the several streets and highways of the city, and as to all other matters relating to their respective service, to submit such practical suggestions as to the elaboration of the general plan of the commission, not at variance with said general plan, as they may desire to submit for the information and consideration of the commission; the same to be submitted within 10 days from the receipt by said companies of copies of this resolution, which the Secretary is hereby requested and directed to communicate to them without delay.

Resolved, That the plan of contract submitted to the commission for their approval by the counsel of the commission, and which their counsel has advised them will be approved by the Attorney-General of the State, be, and the same is hereby made subject to such approval by the Attorney-General, the contract which the commission is ready and desirous to make with any properly organized corporation which may be willing to sign said agreement to act as agent of the commission for the laying, maintaining, and operating of the subway.

Resolved, That, whereas, several propositions have been made and others will undoubtedly be made, to this commission by parties desirous of acting as agents of the commission in the performance of this work, and whereas it is proper for the commission to provide for a consideration of all such propositions, to the end that they may be informed as to which of the parties making such propositions is best able to carry out the said work, to furnish sufficient security for the carrying out of the proposed contract, all such propositions, together with all such as shall be made to the commission previous to their next meeting, shall be referred to the counsel of the commission, who shall report at said next meeting as to such proposals and which of said proposals is in his opinion the best for the commission to accept with the reasons therefor.

Resolved, That the counsel of the commission be authorized to obtain the official approval of the Attorney-General of the contract submitted to the commission in the manner in which the Attorney-General has signified his intention to so approve it.

Resolved, That the engineers of the commission be directed to continue their investigations of the manner in which the plan of the commission should be elaborated for each of the separate services and localities of the city, and to report such facts and data as they may collect from time to time generally.

Resolved, That the engineers of the commission be directed to submit to the commission as soon as possible accurate specifications proper to be furnished to such constructing company as may become the agent of the commission for the carrying out of the work of the length, size, capacity, etc., of an asphalt drawing in-and-out conduit to carry all the telephone, telegraph, etc., wires required in the localities and districts of the city where the commission have decided to begin the work of construction of subways, viz., from Twenty-third to Fifty-ninth street, river to river, and also on 125th street, from river to river.

At the next meeting, on July 16, propositions to undertake the work were submitted by the D. H. Dorsett Company of Chicago, the Consolidated Telegraph and Electrical Subway Company of New York, the New York Electric Lines Company, and the North America Underground and Electrical Subway Company. The contract was thereupon unanimously awarded to the Consolidated corporation.

The Consolidated Telegraph and Electrical Subway Company was incorporated Dec. 26, 1885, under the act of the Legislature passed June 29, 1853, which was entitled "An act to amend an act entitled 'An act to provide for the incorporation and regulation of telegraph companies,'" passed April 12, 1848. The capital stock was fixed at $10,000, divided into 100 shares of $100 each. The incorporators were Henry Fitzhugh, of No. 30 Broad street; Ewald Balthasar, of No. 28 Broad street; Henry J. Davison, of No. 231 Broadway; James B. Houston, of No. 35 Wall street; and Frank L. Freeman, of Washington. The incorporators each held 20 shares of the capital stock. Under the articles of incorporation and the rules of the association the company was authorized to lay wires or electrical conductors in subways in all the streets, avenues and public places of this city, as well as to Albany, Saratoga, Utica, Buffalo, to Niagara Falls, to Oswego, to Watertown, to Brooklyn, to Montauk Point, and to and through every city, town or village lying between or upon the line or lines connecting any two or more of the places already designated. It is also authorized to connect by line or lines any places now reached or covered by any other telegraph, telephone or electric light company. It will be seen that the powers of the company are extensive in their character. The corporation, it was provided, should run for 100 years.

On Jan. 16 the shareholders of the company, who were also the incorporators and directors, met and increased the capital stock from $10,000 to $3,000,000, divided into 30,000 shares at $100 each. This action was confirmed by the shareholders in their capacity of directors on Jan. 23. It is provided in the articles of association that the directors by a three-fifths vote may authorize the conversion of bonds or other securities of the corporation into common or preferred stock. They can sell out their entire company or consolidate with other companies, buy patents or material; and, in fact, every possible power has been reserved in the hands of the board.

Mr. Fitzhugh is President of the Equitable Gas Company, of Chicago, and is said to have confidential relations with he Dickersons, owners of the water-gas patents under which his company operates. Mr. Freeman is a patent lawyer long interested in Bell Telephone, United States Electric Light, Baltimore & Ohio Telegraph and other electrical developments. Mr. Davison has large engineering and gas interests. Mr. Balthasar is a member of the wealthy German banking firm of Hallgarten & Co. Mr. Houston is the president of the Pacific Mail Company and a member of the banking house of T. W. Pearsall & Co. Mr. E. Lauterbach, counsel for the Third Avenue Railroad Company and lately actively connected with the United Lines Telegraph Company, is the attorney of the corporation, which has evidently a highly respectable personnel and a solid financial backing. It is said to be very probable that the Dorsett asphaltum concrete conduits will be used by the company. The assertion is made that the construction company is friendly to the telephone interests concerned. Considering that the telephone wires are largely in the preponderance, it is thought by most electrical people not unreasonable that the Metropolitan Company should use its best endeavors to secure legitimate protection of its interests in the important action now to be taken of placing all wires under ground.

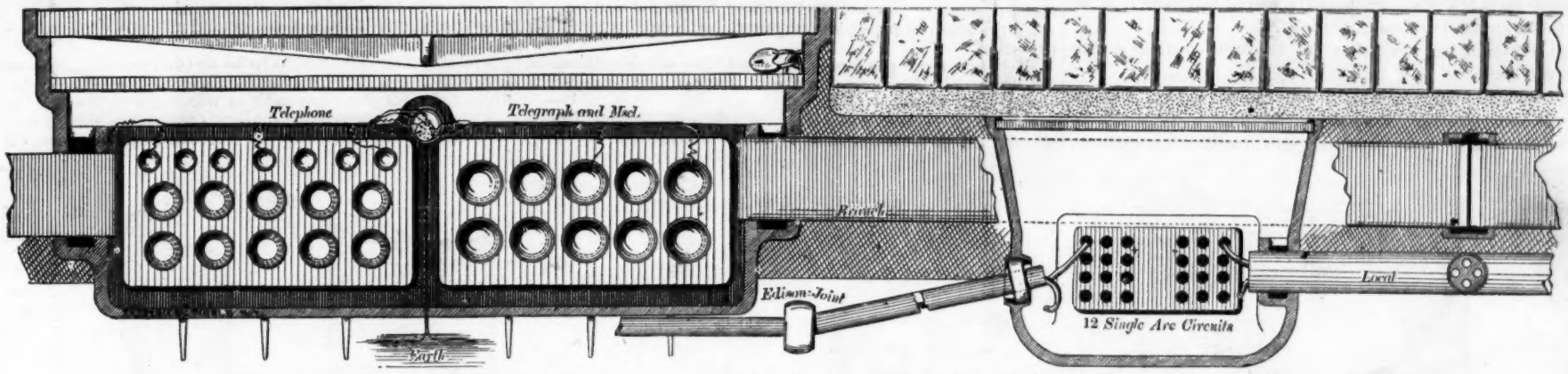


FIG. 1.—VERTICAL TRANSVERSE SECTION OF CONDUIT PROPOSED FOR NEW YORK ELECTRICAL SUBWAYS.

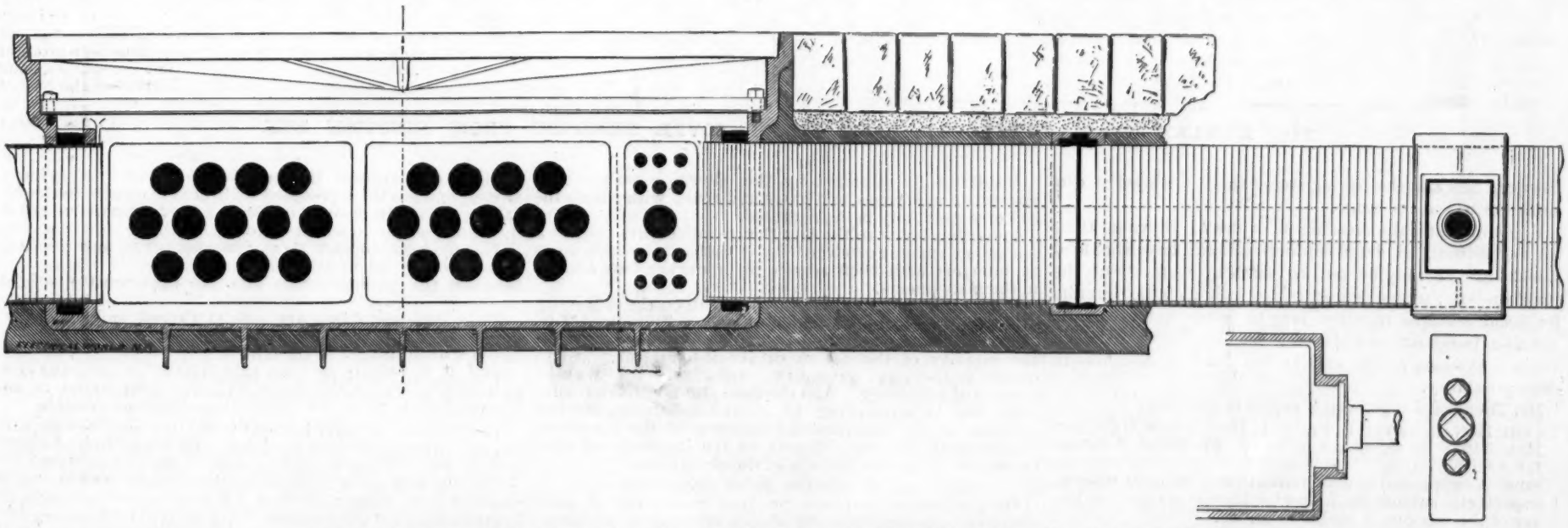


FIG. 3.—CONDUIT SYSTEM AND INCLUSIVE JUNCTION BOX FOR ALL WIRES.

It will be observed that the work begins in the upper part of the city. So far as the wires in the lower part of the city are concerned, it appears to be the opinion of Mr. Flower and his associates, that in lower Broadway a tunnel is necessary to accommodate all the wires. The building of such a tunnel can naturally accompany the building of an underground railway, and it will therefore not be surprising to see the two plans carried out at the same time by one or other of the companies devoting their attention to projects of that character.

Mr. Thomson gives the subjoined explanation of his drawings:

Fig. 1 is a vertical transverse section through an inclu-

sive junction-box for telephone, telegraph and miscellaneous wires, showing a front view of the main conduits and local distributing pipe, and side views of branch conduits. There is here also shown a section of arc or incandescent conduit, with separate junction-box and pipes leading out for local distribution.

Fig. 2 is a plan view developed from Fig. 1, showing covers removed from junction-boxes. This figure shows the splicing or hand-hole box for special local distribution, and the service pipes leading right and left therefrom.

Fig. 3 is similar to Fig. 1, except that an arc conduit is shown as also entering the same junction box with the telephone and telegraph wires. In such an instance this would be an inclusive junction-box.

The large central duct in the arc conduit is for right-hand local distribution, one of the ducts in the telephone conduit being proposed for similar duty for the left-hand side.

Fig. 4 is a plan view developed from Fig 3, and shows the special conduit-sleeve arranged to connect the service-pipe. There is also here shown an arc loop for local distribution taken from the inclusive junction-box.

The dead black portions indicate where bitumen is to be run to make joints or seal openings.

The sectional portion under the conduits indicates the concrete bed.

The section immediately above the conduit indicates asphalt concrete run hot to bring the main body up level with the joints so as to present a uniform bearing surface.

on the face of it, at least, the preliminary work of intrenching electric conductors in New York will be experimental, and so viewing the subject I have been impressed with the necessity of presenting and advising the adoption of a skeleton system comprising such elements or principles only as will permit a reserved and conservative policy in carrying out the change, in that failure in one element shall not thereby militate against the whole, and

Fourth—In view of what I have already suggested respecting the matter of patents, no pretense has been made either to select or avoid patented devices or systems, feeling free to choose from the material presented whatever seemed best adapted to the end in view, thus devising or assembling that which seemed "fittest" by the natural process of "selection."

As to the first section of your resolution, namely, "The elaboration of the plan necessary in providing for different classes of wires," it is apprehended this will in a measure appear by stating—

THE DIFFICULTIES IN THE WAY.

These are of a number and kind presented in like extent or degree in no other city. Among the chief of the mechanical difficulties may be mentioned the combination of gas, water, and steam pipes and sewers; that in nearly all sections of the city the vaults extend fully out to the curb line, and in many instances beyond it beneath the streets; the great number of wires generally distributed, and the densely congregated masses in special sections of the city, and the provision required for local distribution of wires.

The foregoing purposely omitted the consideration of the difficulties from an electrical point of view, but both are interdependent.

Electrically, the obstacles to efficient service under ground are insulation, induction and retardation.

nect a system of man-holes; for, when the existing condition of the streets beneath their surface is considered, as relates to sewers, steam, water and gas mains, branches and pipes, the problem of *threading* a conduit betwixt these obstructions of necessary capacity to offer inclusive service becomes most serious. It is not submitted that as a feat of engineering it would be impracticable; but, to say the least of it, the work would be expensive and tedious of accomplishment.

A final objection to conduit and man-hole systems pertains to their lack of adaptibility to outlying sparsely-wired districts.

It therefore appeared upon this view of the subject that the conduit system should be of such character as to utilize the only free and comparatively unobstructed sections of the streets, namely, that between the paving stones and the existing line of pipes.

THE SYSTEM.

The system proposed for your consideration and adoption will now be described under the tabulation to which its selection was required to conform.

FIRST.

A subway or conduit in which wires may be placed, used and owned by the electric companies, involving the minimum cost of construction, in that the rental or tax for the use of the same shall not be burdensome upon its tenants.

The main trunk of the system consists of a conduit or contiguous conduits, and connected at intervals with inclusive junction-boxes.

The main sections ought to be rectangular in cross-section and perforated longitudinally by a series of ducts of proper size for the receptacle of wires and cables.

The junction-boxes are shallow cases formed by a single casting of iron, sunk into the street surface until the edge

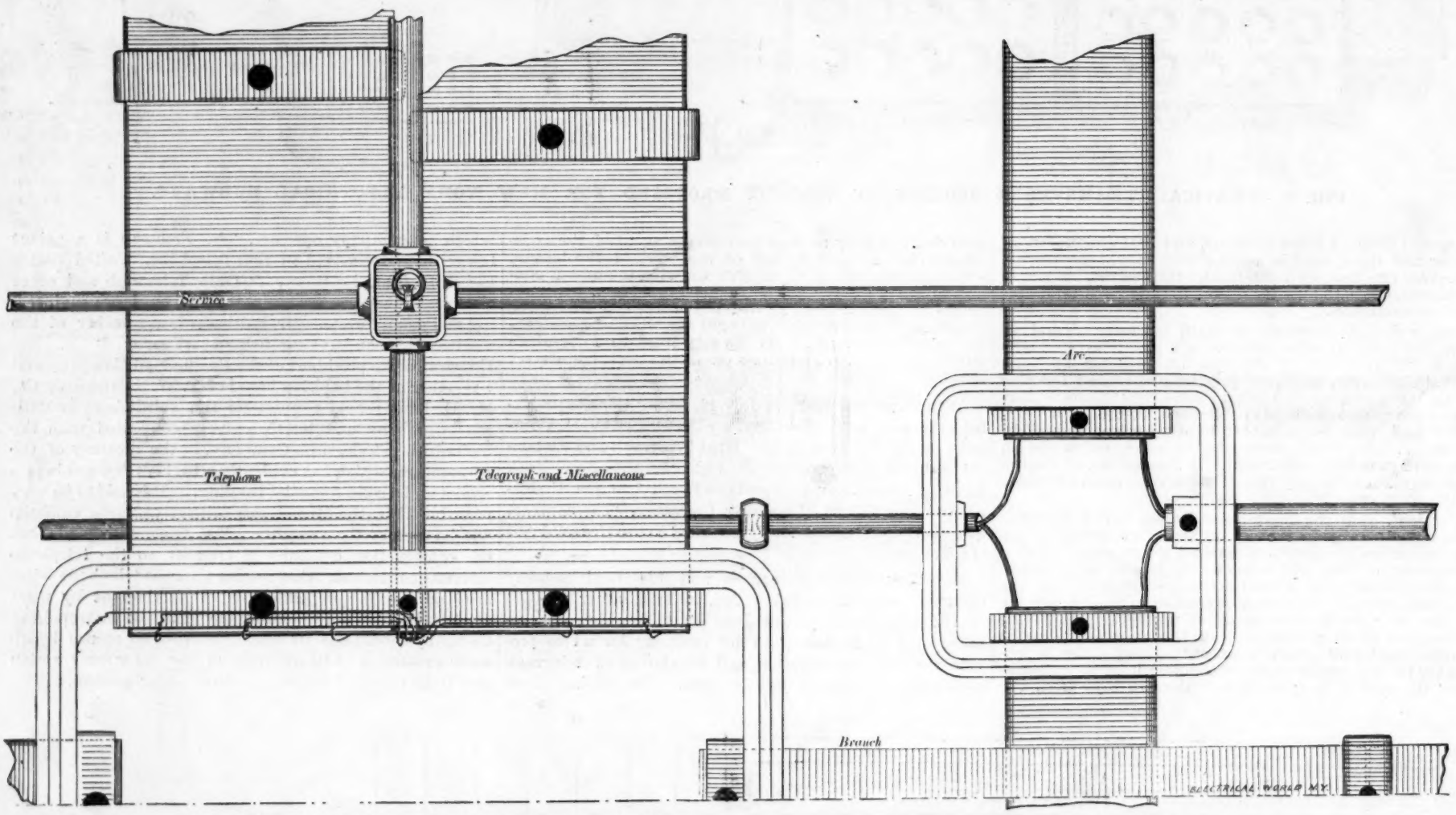


FIG. 2.—PLAN VIEW, DEVELOPED FROM FIG. 1.—COVER REMOVED FROM JUNCTION BOX.

Between this and the paving stones there is a layer of dirt sufficient to bed the same.

Fig. 4 indicates the crossing of cables to alternate their linear position, to avoid induction, and how the lead shields are or may be put to earth by contact with the junction-box; it also demonstrates how metallic circuits for local sections of wires may be made, and also how metallic induction shields may be interposed between distinct systems which may be run for long distances in close proximity.

Mr. Thomson's engineering report is as follows:

TO THE HON. ROSWELL P. FLOWER, HON. JACOB HESS AND HON. THEO. MOSS, *Commission on Electrical Subways for New York City.*

SIRS: As requested in your resolution of June 30 ultimo, I respectfully submit the following inclusive report in the order of the sections of said resolutions.

PREFACE.

I deem it incumbent on me at the outset, before dispensing with the personal pronoun, to define my position as to matters pertaining hereto.

First: In the following I have made free excerpts from the communications which I have previously submitted to you or been identified with; subject, however, to such modifications and additions as have occurred to me up to the present time, in that the entire subject may be handed down complete and free from references.

Second: In my judgment, many phases of the underground problem are yet in the tentative stage and a satisfactory demonstration thereof can only be accomplished by but one test—namely, that of time and practice.

Third: While I am aware that many assertions, apparently authoritative, have been made in advance as to the complete success of the underground problem, it is yet respectfully submitted that we have not been referred to an instance in practice equal to the case in hand. Therefore,

Insulation is impaired by the alternate presence of moisture and dryness, and gases and acids, with which the soil of a great city is impregnated.

Induction is due to the fact that parallel wires induce a secondary current of electricity in each other which tends to interfere with their service by producing false actions in the instruments.

Retardation in extent is consequent upon the proximity of a wire to the earth which effects a limitation of its electrical charge and discharge, thereby interfering with the rapidity of the action of the instruments. This is doubtless the most prominent obstacle in the way of successful telephony. And the final and controlling difficulty lies in attempting to combine different electric systems, as the infinitesimal delicacy of the telephone compared against the Niagara of the incandescent electrodes, or the terrific tension of the arc circuits.

THE CLASS OF SYSTEMS TO BE INVESTIGATED.

The restrictions imposed by your resolution at once eliminate the consideration of such systems as premeditate permanently imbedding the wires and cables; also of strictly wire or cable systems or tunnels. The plans thus segregated comprise cellular systems only.

As to conduits combined with working chambers or vaults at convenient distances apart, these were also discarded for the following reasons:

First: In that the subterranean working chambers, or man-holes, to be of any practical use, would require to be of large size and considerable depth—probably not less than seven and one-half feet. The difficulty of keeping a vast number of such *wells* approximately free from moisture and from gas (the latter liable to accumulate to explosive charges, and to be exploded, and the restricted and inconvenient space within which to manipulate the cables and wires, would render such systems liable to serious damage and would be exceedingly inconvenient to properly inspect or supervise. But the controlling objection inheres in the lack of available space, and this also brings up the second general reason against the conduit requiring to con-

of the open portion of the box is flush with the paving stones, and are then provided with heavy outside covers taking the strain of street traffic, and inside covers screwed down on gaskets to secure water-tight joints.

The conduits connect these junction-boxes, and it will therefore now be understood that they are laid to *skim* between the paving stones and the uppermost line of pipes.

The cables and wires are spliced, tapped and handled generally at the junction-boxes, the operators being virtually upon the surface of the streets.

The conduit sections after being laid in position are to be joined to form a continuous subway in the following manner:

The sections are first brought into alignment by inserting metallic mandrels in the ducts, and a cast-iron sleeve is then slid over the contiguous ends of the said sections.

This sleeve is made to fit the sections snugly, and is constructed with flanges, to form a hollow recess, extending around all sides of the sections. An opening extends through the sleeve on its upper side, and to this opening steam hose is secured, and steam turned on. The consequence of this is that the ends and sides of the sections within the recess formed by the sleeve are made plastic. The hose is then removed, and melted asphaltum is run into the opening, completely filling all the space within the sleeve and around mandrels between the faces of the section. The union thus formed is complete, the joint being *welded* to form a homogeneous mass throughout; and hence, in connection with the added strength of the sleeve, insures as great strength at the joint as at any other portion of the sections.

Where the sections enter the junction-box, a cored recess is formed in a manner similar to the sleeve, and by like process the section is secured thereto.

The controlling advantage of this process is that the conduit will be made water and gas tight throughout, and that the several ducts will be maintained with perfect continuity from junction-box to junction-box.

Prior to the installation of the system, the bottom of the trench is to be filled with béton or asphaltum concrete to a depth of say four to six inches, thereby forming a level and solid bed upon which to lay the sections, and to this extent reinforcing the sections. After the sections are laid and joined, a layer of nearly pure asphaltum is then run on the upper surface, say one inch deep, and over this say three to four inches of sand, or just enough in which to bed the paving stones and insure a uniform area of bearing surface.

All wires and cables in the conduits will be accessible from the junction boxes, and in consequence of their proximity to the surface the cables may be readily inspected, inserted or withdrawn; hence this system so far fully meets the first important requirement of a conduit or subway in which the wires may be placed, used and owned by the companies, and which is also susceptible of thorough control and supervision by the proper authorities.

SECOND.

Adaptability to existing streets, whereby to involve the least interference with traffic, gas, water and steam, mains and sewers.

The proposed arrangement of conduits and junction-boxes seems to offer the greatest pliancy of adaptation, in that the actual work of intrenchment will involve comparatively little special devising to meet existing conditions.

THIRD.

Adaptability of the conduits to distinct electric systems as arc lighting, general telegraph, telephone, alarm, messenger call, etc.

While it may not be unfeasible in special instances to include all classes of conductors in a single conduit to be handled at junction-boxes common to all, it is yet deemed the more prudent and safer course to require a distinct separation of systems for distinct classes of conductors. In fact, this will be a necessity in the down-town districts, as the number of conductors to be accommodated would preclude a strictly inclusive system on any plan other than a tunnel.

It is therefore recommended:

I. That the main or trunk conduits so far described be used for telephone and general telegraph wires only.

II. That the arc circuits be isolated as far as possible from the general conduits. For this purpose concrete sections similar to the main sections described will be laid, but having ducts about ¾ inch in diameter and preferably of sufficient number to provide a pair of ducts for each circuit.

The arc wire conduit will also be provided with junction-boxes for the purposes of drawing in wires, splicing, and distribution.

Wherever necessary the arc conduit should be laid on a lower plane than that of the main conduit in that each may pass the other.

III. That the incandescent conductors be also separately incased; but for this purpose no recommendation can be made that would appear to supersede the Edison system already laid in this city, in that it has been successfully installed and stood the test of about four years' constant duty with general satisfaction, so far as can be ascertained.

While an incandescent system might be devised for inclusive or general service of different companies using incandescent conductors, it will doubtless yet be cheaper, more satisfactory and safer to provide separately for different companies, in consequence of the conditions peculiar to incandescent systems. It is also probable that a system analogous to the Edison conduit will be best adapted for conductors used in the general transmission of power, a contingent quite probable in the immediate future.

In extending the main conduit systems by cross-connections and branches, and to tracts of the city not thickly wired, it is proposed, in such instances, to simply lay heavy iron pipes of sufficient capacity to meet such service. They will radiate from the junction-boxes at street intersections in the same manner as that of the main conduits.

But the probable limit to the use of single pipes, either in the cross branches or in extending the main trunk sections, will be that in which a single cable will afford a sufficient number of conductors for the required service.

The second section of your resolution relates to

"*The mode of distribution best adapted to the wires of different electrical service.*"

This has been presumed to refer chiefly to the local or unitary distribution of single conductors, or a plurality of conductors, to blocks, buildings, dwellings, etc.

Regarding this matter much attention and consideration have been given, and as a mean resultant of all the different plans, schemes and suggestions, it is recommended, wherever practicable, to distribute from the centre of blocks, bringing the wires thereto through a special pipe from the nearest junction-box or boxes.

Take it all in all, this is doubtless the cheapest, most practical and generally satisfactory mode that can be adopted.

In special instances, however, this may require to be otherwise provided for, and in such cases the following plan is proposed:

A small iron pipe may be laid on top of the main conduits, thus bringing it in close proximity to the street surface. This pipe would be connected to the junction-box in the same manner as the main conduit sections. At suitable intervals—as, say, one for every two buildings—a small hand service-box is provided, having a sealed cap. This cap comes up close to the paving stones, and is reached by removing the stones above it, and from these boxes radiate to the right and left smaller service pipes.

A local connection may be made as follows: A cable being selected at the nearest junction-box, a wire long enough to reach to the house to be connected is then drawn into and through the local pipe to the service box corresponding to the house, from whence it may be turned and led through a service or protecting pipe into the house. It is then connected to the main wire at the junction-box and to the instruments within the house, the service-box cover sealed and paving stones replaced. Or the conduit company may at the outset draw in enough wires in the local and branch pipes to meet the probable local demands of the blocks, when it simply remains to connect the proper wires at the junction-box and instruments.

A further modification for local distribution may be offered, in which the outside ducts on the right and on the left of the main conduits are used, these being connected by a sealed cover in the side of special sleeves used in connecting the conduit sections. From these sleeves small pipes project passing to the vaults or curbs, in a manner analogous to that already described.

Iron pipes for carrying out loops for local distribution of the arc circuits will connect with the boxes, and the pipes may be deflected where necessary to pass under the main sections. These pipes may also be filled with non-conducting mastic, or separate ducts be formed therein depending upon requirements.

General Features of the System—Recommendations and Suggestions.

The outside junction-box cover, loosely placed in position, takes the wear and jar of street traffic and gives access only to the internal sealed cover, which latter is thereby relieved from excessive strains.

The junction-box system would seem to offer controlling advantages, among others, in that—

1. The cables may also be completely encased through the junction-box.

2. That partitions may be formed within the junction-boxes providing separate compartments for different systems or companies, thereby effecting a complete separation in an inclusive box; and

3. Where the demands of the service may warrant, junction-boxes may be provided with separate covers, or distinct and separate boxes also may be furnished.

All service pipes not in use should be carefully sealed and the ducts of the main conduits, where they open into the junction-boxes, also be sealed as completely as possible.

Thus the conduit will practically be *hermetically sealed* throughout its whole extent.

The iron pipes should be thoroughly treated by coating the sections very heavily with coal-tar pitch to prevent rusting; and also in that such treatment would effect a degree of insulation in the pipes. But the junction-boxes are recommended to be treated by the Bower-Barff oxidizing process to prevent corrosion only, as it is desirable to put the junction boxes in the most intimate ground contact for the purpose of electrical tests, and for the dissipation of induced currents; the lead shields of cables being connected to earth at the junction boxes only.

The bottom of the junction-boxes should be formed with thin sharp ribs projecting therefrom, thereby putting them to "ground" through a large area of contact.

The cables may also be crossed over at the junction-boxes so as to run in alternate proximity.

While this arrangement would reduce the disturbing effect of contiguous wires due to induction, the extreme delicacy of the telephone instruments may require that further precaution be taken, and for this purpose it may be necessary to adopt a double line; which, as is well known, relieves the telephone wires from disturbances, both from outside wires and from one another.

But where single telephone wires are employed, it is suggested that a double line may be used from the junction-box to the instrument, the wire being put to earth at the junction-box. This would be applicable in instances where this portion of the circuit would offer the greater chances of disturbance.

In special instances it might be desirable to bring to inclusive junction-boxes a few arc circuits, in which case it is suggested that lead covered wires may be carried along and secured to the bottom or sides of the junction-box, and for local distribution a loop be taken through a separate pipe without disturbing the wire in the conduit. Such arc circuits should be disposed plus and negative in close series, thus balancing, or nearly so, their disturbing effect on the telegraph or telephone wires.

The disturbing effect of contiguous systems due to induced currents may be further eliminated by placing a thin shield of metal, preferrably of copper, between the conduit sections, the said shield passing down through the bed of concrete to earth and also connected to the junction-boxes. But this would apply only when the conduits were laid close and parallel to each other.

In special cases of proximity to steam pipes the conduits should be protected by sheathing the same with mineral wool, in the instance of the concrete to protect the section itself, and in the instance of the iron branches to protect the cables or wires therein.

FINALLY.

The foregoing attempts to briefly outline only the guiding or dominant features to be kept prominently in the foreground when reviewing, supervising or guiding, as the case may be, the coming work. In fact, to attempt more than this, in view of all the circumstances, would involve a temerity of which the writer is not capable. To now attempt to rigidly specify would be like an argument without a premise. But, even as it is, much yet remains to be considered, and which it now appears can be intelligently passed upon only as the actual work of installation progresses.

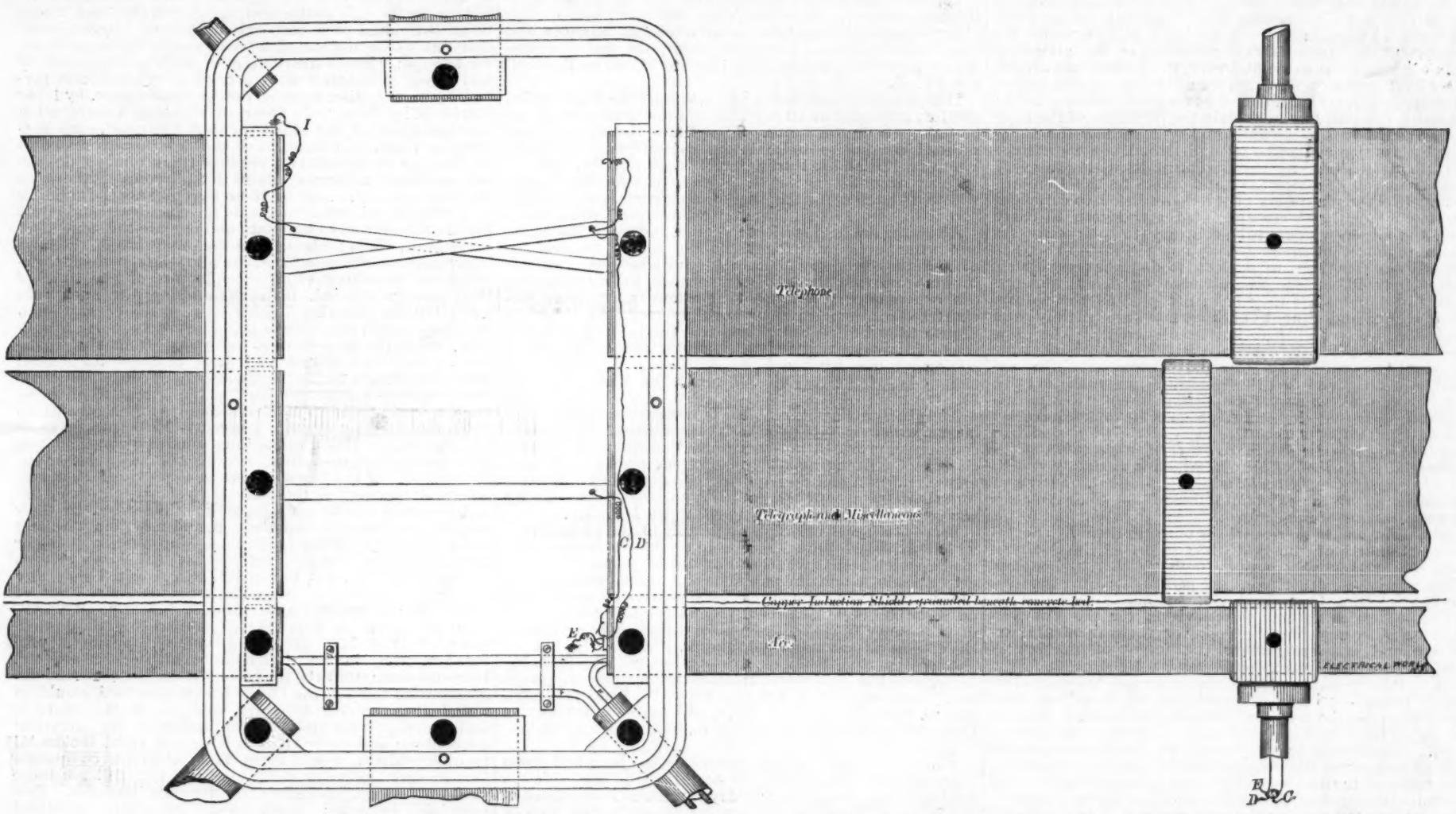


FIG. 4.—PLAN VIEW, DEVELOPED FROM FIG. 3.—SHOWING SPECIAL CONDUIT SLEEVE.

Hence it is submitted that the ultimate object will be more surely and more speedily accomplished by causing the work to be begun at the earliest date practicable; but in a section of the city where the complications and requirements are comparatively moderate; whereby processes may be refined and corrected, but the work generally be pushed forward and extended in a ratio commensurate only with the preliminary success.

Respectively submitted, JOHN THOMSON.

NEW YORK CITY, July 13, 1886.

The following is the opinion of Mr. Gibbens, counsel for the Commission:

To the Commissioners of Electric Subways for the City of New York:

The resolution of the Commission which calls for this report reads as follows:

Whereas, The Commission have no funds, and there are no means at present existing by which such funds can be raised by the Commission; and

Whereas, It is important that the placing of wires underground shall begin at the earliest moment possible; and

Whereas, The Commission are advised by the Attorney General of the State that they may properly engage with a construction company for the performance of this work:

Resolved, That the counsel of the Commission be called upon to report, at the next meeting of the Commission, *generally as to a company*, to lay, operate and maintain the subway, *under the direction and control* of the Commission, and to suggest to the Commission *all necessary legal precautions and safeguards in the government of such company*, with a general *plan of contract* to be made by the Commission with such company, which plan, before it is adopted by the Commission in any form, shall be submitted to the Attorney General for his official criticism.

Now, while there is nothing in this resolution authorizing it, if the Commission will bear with me for a few moments, I should like to state what I believe to be the position of the Commission in reference to the giving of this work to a company, and why, if I understand aright, they have called on me to report *as to a company* rather than as to some other mode of having the subway built; in short, I should like to explain the preamble of the resolution as it seems to me and amplify it, so that the Commission's action cannot be misunderstood, the more since certain articles have appeared in print discussing this very matter in a light somewhat unfavorable to the Commission. It is the plain duty of the Commission to carry out the law which they were appointed and sworn to carry out, and not only would it be contrary to their duty for them to do what the law does not tell them to do, but equally so for them to neglect to do what it directs they shall do, or to procrastinate or delay unnecessarily in doing what they have accepted as their duty. The spirit and intent of the law are plainly and unmistakably set forth in its language. The law provides that for a certain specified length of time it shall be the duty of the Commission to examine such plans as the electric companies of this city choose to submit for putting their wires underground, and after that time, if suitable plans have not been submitted, it is made the duty of the Commission *to cause to be devised and made ready for use a subway conforming to the spirit of the act*, which is distinctly stated, *and to compel the different companies to use it.* I have no hesitation in advising the Commission that their duty lies in the direction of the course they are pursuing and in no other. For what other course is open to them? The Attorney General of the State has informed the Commission that the subway may be built "either by contract with a private corporation or person, or, in the discretion of the Commissioners, by labor employed by them." Now as there is no provision for the Commission to raise any money except for their incidental expenses and salaries, and as the intent of the law is plainly that the subway shall not be a charge upon the city or the State, the second clause of the Attorney General's remark—"by labor employed by them"—is only possible under the power which the Commission have, of charging incidental and necessary expenses to the companies. While it is fair to *infer* that the Commissioners under the clause allowing them this power of providing for expenses in carrying out the law are legally authorized to build the subway themselves and pay for its construction by assessment upon the companies, it is not so explicitly stated in the act as to free the question from all doubt, and the experience of the Commission in the matter of payments by the companies has not been such in the past as to warrant the expenditure of so large a sum of money on a mere inference, and furthermore, there is no occasion for the Commission to proceed in such a way as would perhaps render them individually liable for whatever expenses might be adjudged outside of the words "necessary and incidental," provided they can find another way equally good not open to this objection.

Reverting to the first clause of the opinion, "*by contract with a private corporation or person*," it becomes necessary to inquire what valid consideration the Commission can proffer to such corporation or person for building the subway. Plainly the Commission cannot bind the city or State—plainly they cannot bind the electric companies to pay for the subway (except again under the right that is granted of charging them with necessary expenses of the Commission in carrying out the law), though they can by the terms of the act compel them to use it. It remains for them to proffer the exercise of this compulsory power of theirs as consideration for the promise made by the construction company, and this they propose to do. It has been affirmed that the Commission could make such a contract as would give the different electrical companies the right—if they so elected—to purchase certain portions of the space of the subway which they respectively need outright; but it must be borne in mind that the companies have had an opportunity to build and own subways and have failed to do so. It has also been said that the law should simply provide that the Commission should compel the companies to put their wires underground, each in its own subway, made to conform to the plans of the Commission; and furthermore, that the law ought to provide that the city shall in some way be assured of a revenue from the subway, and again that the law should provide that the subway should be owned by the city and should comprehend water pipes and gas pipes, and should provide many other things which would be to the advantage of the city or of the companies. However, the law does not provide any of these things. It does not provide any means out of which the subway can be built, and it gives the Commission no choice whatever but to make the best bargain it can for the city and the companies with whomsoever, in return for the Commissioners' promise to do everything in their power to compel the use thereof, may be willing to contract to build and maintain the plan you have adopted. It is not the part of the Commission or its officers to criticise the law or the way it is drawn. It is not their part to say in what respect it may be improved. But it is your plain duty, a failure in which would be inexcusable, to conform, so far as is in your power, to the intent of that authority which created your office, "which is to convert the overhead systems of electric wires and cables now in use to underground systems, as soon as possible, without impairing the efficiency of their service." The question of the validity or the invalidity of the law creating the Commission and from which it derives its powers, is one of course with which the Commissioners have nothing to do as far as their own action is concerned. But as such question would probably be raised by those persons contemplating the organization of a company to build the subway proposed, I thought it wise to examine this question with some care, and it would seem that the matter is no longer in doubt.

That the police power of the State extends to making regulations promotive of domestic order, morals, health and safety, has been established by an uninterrupted course of decisions by the courts of last resort in the several States and in the Supreme Court of the United States; and this principle would justify exclusion of property dangerous to the property of citizens of the State, and the passage of sanitary laws and laws for the protection of life, liberty, health or property within its borders. R. R. Co. *vs.* Husen, 95 U. S., 465 (471,472), or to prohibit the use of a dangerous article within the State, as an illuminating oil, even though patented. Paterson *vs.* Kentucky, 97 U. S., 501.

The State has a right to control the use of a poison, although patented. Weber *vs.* Virg., 103 U. S., 344.

So the power to regulate manufacture of naphtha and oils is purely in police powers of the States, and Congress has no power to regulate them therein. U. S. *vs.* De Witt, 9 Wall., 41.

This power extends to the protection of the lives, limbs, comfort and quiet of all persons, and the protection of all property within the State. So a State statute requiring railroad companies to maintain cattle guards is valid. Thorp *vs.* Rutland & Burlington R. R. Co., 27 Vt., 149.

This power also enables the State to regulate the charges within its borders for the use of an article, even though patented. Hockett *vs.* State, 5 Northeastern Rep, 178.

All rights are held subject to police powers of the State, and if the public safety or the public morals require the discontinuance of any manufacture or traffic the Legislature may provide for its discontinuance notwithstanding the owners may suffer. So that where a company was chartered for the purpose of brewing beer, the Supreme Court of the United States held that the passage of a prohibitory law preventing the manufacture of beer was a competent one for the State to make and was valid as against brewing companies. Beer Co. *vs.* Mass., 97 U. S., 25.

And the State is not inhibited from enacting police regulations which operate upon instrumentalities or articles of commerce, provided no discriminations are made against classes of citizens and no restrictions placed upon commerce. Thus a statute requiring persons offering patents for sale to file a copy thereof with an affidavit of validity was held good. Brichill *vs.* Randall, 102 Ind., 528.

There is another principle applicable to the present case which gives additional strength to the contention here made, which is that when the owner of property devotes it to a use in which the public have a use he must submit to be controlled by the public for the common good. And property becomes clothed with a public interest when used in a manner to make it of public consequence and affect the community at large. Mumm *vs.* Ill., 94 U. S, 113.

And all persons using electric conductors will probably be regarded in legal contemplation as devoted to public use. State *vs.* Nebras. Tel. Co., 22 N. W. Rep., 237; State Mo. *vs.* Bell Co., 23 Fed. Rep., 539; State *vs.* Tel. Co., 36 Ohio, 286; Amer. Rapid Tel. Co. *vs.* Com. Tel. Co., 44 Am. Rep., 237.

And in this State the same principle has been laid down with emphasis by the Court of Appeals, who say: "It is a bold assertion to say in this day that there is anything in the State or United States Constitution conflicting with or setting bounds upon the legislative discretion or action in directing how, when and where a trade shall be conducted in articles intimately connected with the public morals or public safety, public prosperity, or indeed to prohibit and suppress such traffic altogether if deemed essential to effect those great ends of good government. Board of Excise *vs.* Barrie, 34 N. Y., 657 (666).

The following additional cases will show how widespread and well-settled these principles are: Chicago R. R. *vs.* Iowa, 94 U. S., 155; Peik *vs.* R. R. Co., *id.*, 164; *Id. vs.* Ackley, *id.*, 179; Winona R. R. *vs.* Blake, *id.*, 180; R. R. Co. *vs.* Richmond, 96 U. S., 521 (holding that an ordinance prohibiting use of steam engines in the city is valid); R. R. Co. *vs.* Fuller, 17 Wall., 500; Olcott *vs.* Supervisors, 16 Wall., 678; Spring Val. Water Works *vs.* Schlotter, 110 U. S., 347; Ruggles *vs.* People, 91 Ill., 256; *Id.*, 108 U. S., 526; Ill. Cent. R. R. *vs.* People, 108 U. S., 541; Allmitt *vs.* Inglis, 12 East., 527; Mayor *vs.* Yuille, 3 Ala, (N. S.), 137; N. J. Nav. Co. *vs.* Bank, 6 How., 344; Com. *vs.* Duane, 98 Mass., 1; Com. *vs.* Tewksbury, 11 Metc., 55; Com. *vs.* Alger, 7 Cush., 53; Slaughter House Cases, 16 Wall., 36; Thorpless *vs.* Mayor, 21 Pa., 147; Grant *vs* Courter 24 Barb., 232; Bartemeyer *vs.* Iowa, 18 Wall., 129; Ogden *vs.* Saunders, 12 Wheat., 213; Paterson *vs.* Com., 11 Bush., 311; Sibbons *vs.* Ogden, 9 Wheat., 1. 2: City of N. Y. *vs.* Miln, 11 Peters, 102; State *vs.* Teleph. Co., 36 Ohio, 296. (38 Amer. Rep., 586); Jourdan *vs.* Dayton, 4 Ohio, 295; Fry *vs.* State, 63 Ind., 552; People *vs.* Russell, 49 Mich., 617 (14 N. W. Rep., 568); Thompson *vs.* Staats, 15 Wend., 395; Martinetti *vs.* Maguire, 1 Deady, 216; Vammini *vs.* Paine, 1 Harr., 65; License Tax Cases, 5 Wall., 462; Palmer *vs.* State, 39 Ohio, 236; W. U, Tel. Co. *vs.* Pendleton, 95 Ind., 12; Indianapolis, etc., R. R. *vs.* Kercheval, 16 Ind., 84; W. Va. Co. *vs.* Oil Co., 5 W. Va., 382; State *vs.* Perry, 5 Jones, 252; Atty.-General *vs.* R. R. Co.'s 35 Wis., 425; Foster *vs.* Kansas, 112 U. S., 201; Toledo Agricultural Works *vs.* Work, 70 Ind., 253; Kent's Com., 340.

It would thus seem clear that the Legislature has, in passing the laws in question, in nowise exceeded its powers in that those laws are binding upon all persons, and it may be further asserted with confidence that the power being so plainly in the State and the disposition of the State being so plainly that the wires shall be put under ground, the State will not allow its purpose to fail for lack of such additional legislation as may be necessary, if any such additional legislation is necessary, but will support and confirm the Commissioners in what they may impartially and honestly decide to be the best method of carrying out the State's intention as it appears in the act.

I have taken it that the language of your resolution—"*Generally as to a company to lay, operate and maintain the subway under the direction and control of the Commission*," indicates that you desire to be informed:

1st. Whether a company already existing can be empowered for the purpose.

2d. Whether a company not existing can be formed for the purpose.

3d. Whether the control of the underground system can be kept in the hands of the Commission.

4th. Whether the company can issue mortgage bonds for the money required in the work.

5th. Whether the Commission can convey the power to lease space in the subway to the company.

Chap. 499, Laws of 1885, creates a Commission charged with the duty of carrying out the provisions of chap. 534 of the Laws of 1884.

By section 4 of chap. 499, Laws of 1885, it is provided that if no suitable plan is proposed or in use within sixty days after the passage of the act, it shall be the duty of the Board to cause to be devised and made ready for use such a general plan as will meet the requirements of said act. *By this act the Board is given full authority to compel all companies operating electric wires to use the subway prepared in accordance with the provisions of the act.*

It would, therefore, appear that inasmuch as no suitable plan was proposed or in use within sixty days after the passage of said act, the board is authorized and it is its duty to cause a general plan to be devised and made ready for use to carry out the purposes of said acts; and it would seem that this can be done by the Commission itself, or by its duly authorized agent, whether such agent be an individual or a corporation, and the Attorney-General has (as already stated) advised you to the same effect, for he says: "The construction of such subway may be had either by contract with a private corporation or person, or in the discretion of the Commissioners, by labor employed by them." In order to authorize a corporation to act as agent of the board for such a purpose, such corporation must, of course, have power either expressed in its charter or necessarily implied therefrom, to do the acts necessary to properly fulfil the purposes of the laws above mentioned. Among those purposes are the building of a suitable subway into which all electrical conductors may be placed, and to maintain and operate the same after being built. It is probable that the provisions of the laws above mentioned are sufficient to allow any company existing and operating electric conductors at the time of their passage to build, maintain and operate such subways, but the question might arise, whether any such company would have power to lease space in such subway, unless the same were to be implied from the provisions of said laws of 1884 and 1885, or from its general powers conferred by law or implied therefrom. But as no such company has availed itself of the provisions of those laws, it is necessary to inquire if there is any legal authority in this State by which a company could properly act as agent for the Board in building such subways, and in maintaining and operating, leasing the same hereafter. By chap. 425 of the Laws of 1862, it is provided that any telegraph company in this State may construct, own, use and maintain any line of telegraph not described in their original certificate of organization, and may join with any other corporation in constructing, leasing, owning, using or maintaining such lines. And by chap. 397, Laws 1879, as amended by chap. 483, Laws 1881, it is provided that any telegraph company is authorized to construct lines of electrical conductors underground in any city, village or town in this State subject to the provisions of the law governing such companies, provided it first obtains the consent of such cities, etc. It would seem that the provisions of these acts read together with those of the Laws of 1884 and 1885, would be sufficient to enable a telegraph company in this State to build, own, operate and maintain subways for electrical conductors; and as the right to lease is a right incidental to ownership, it would seem that telegraph companies owning such subways would have power to lease those parts of it not necessary for its own business. This principle is acted upon and frequently practiced in this State, as many telegraph companies are in the habit of permitting telephone, electric light and district messenger service companies to string wires upon their telegraph poles for hire. By chap. 611, Laws of 1875, it is provided that "Corporations may be organized under the provisions of this act, for the carrying on of any lawful business except banking, insurance, the construction and operation of railroads, or aiding in the construction thereof, and the business of savings banks, trust companies, or corporations intended to derive profit from the loan or use of money, or safe deposit companies, including the renting of safes in burglar and fire-proof vaults." There can be little question but that a company organized under this law with proper provisions duly stated in its articles of incorporation would have full power to build, maintain and operate a subway such as is contemplated in the acts above referred to, and to lease space therein.

In order to create such a company, five (5) or more persons, a majority of whom shall be citizens, residents of this State, must make a certificate, signed by each of them, duly acknowledged and setting forth:

1. The name of the proposed corporation.
2. The object for which it is to be formed, including the nature and locality of its business.
3. The amount of subscription and the capital stock.
4. The number of shares of which such capital stock shall consist.
5. The location of the principal business office.
6. The duration of the corporation, which shall not exceed 50 years.

This certificate is filed with the Secretary of State, who issues a license to the persons signing the certificate, empowering them to receive subscriptions. When one-half of the capital stock has been subscribed for and 10 per cent. paid in, the subscribers may meet and organize; upon filing a verified record of the proceedings of such meeting with the Secretary of State, he issues a certificate of corporation, a copy of which is filed with the clerk of the county where the principal business office of the corporation is situated. Such company may be either limited or unlimited liabilty of stockholders. It would thus appear that a corporation can be created under the laws of this

State with power to build, maintain and operate a subway of electrical conductors and to lease space therein. A corporation is impliedly authorized to borrow money, and has the incidental power to give security for its repayment. And this power has been repeatedly exercised by telegraph companies in this State without question. It would thus appear that the money required for the building of the subway by a telegraph company may be legally raised by its bonds secured by mortgage. This power also is possessed by companies organized as above suggested, but in such cases they are restricted by the said Act of 1875, section 13, which provides that the amount of bonds outstanding at any single time shall not exceed one-half of the corporate property of such corporation. By section 6 of the Act of 1885, the term of office of the Commission expires on November 1, 1887. It would appear to be pertinent for the Commission to make a contract with the company building such subway, by which the supervisory control thereof should remain with the Commissioners during the remainder of their term of office, and with successors having power to exercise such control as the parties should agree.

II.

We now come to that part of the Commission's resolution which speaks of "necessary legal precautions and safeguards in the government work of such company."

In a general way it may be said that there are four parties in interest in this matter: (1) The people. (2) The Commission. (3) The companies operating electrical conductors. (4) The company which will act as agent for the Commission in carrying out the will of the people.

The interest of the first named—the people—is plainly indicated in the act and identical with the duty and interest of the Commission, viz.: That the wires shall be placed under ground—speedily, safely, without expense to the people or commission—without deteriorating from the efficiency of the electrical service as it is at present. The interest of the companies is bounded by the cost and trouble of changing from an overhead to an underground system, of maintenance when so changed, in securing such facilities as they may need on fair and impartial terms, and in being guaranteed against interference with their conductors and the impairment of their efficiency.

The interest of the constructing company is in securing a fair return for the investment made in carrying out the plan of the Commission for the laying, operating and maintaining the subway.

It may safely be said that if the Commissioners can provide satisfactorily for, 1st, the proper laying of the subway; 2d, the proper allotment of spaces within it; 3d, the proper adjustment of rentals; 4th, the proper supervision of wires and freedom from interference; 5th, the proper protection from lawsuits; 6th, the proper security for carrying out the agreement, and 7th, the proper adjustment of disputes, they will amply protect the rights and interests of the people, the electric companies and themselves, while all other points, such as the cost of the subway to the company and the government of the company in its own affairs not conflicting with the points noted, may be left to the company itself for its own protection. It does not make the slightest difference to the public or the electric companies or the Commission who the constructing parties are, provided their security is ample—nor how much the subway costs, provided it is laid satisfactorily and honestly—nor how much the company makes on its investment, provided the charges are properly regulated and reasonable—nor where it buys material, provided the material bought is up to the standard, and the city and C mmission are protected from responsibility—nor how much space is rented to any company using electrical conductors, provided every other such company can get what space it desires—nor how often or much one company changes or repairs the wires, provided it does not, in so doing, interfere with the wires of some other company. The Commission in adopting a general plan for laying the subway, have adopted, with excellent reason, the principle of retaining in their own hands the power to adjust the details of their plan to the circumstances of cases which will arise as the work is going on; and following their example, I have considered that the most satisfactory provision which could be made for disposing of the important questions arising in the relations between the Commission and the Construction Company and the electric companies would be to leave in the hands of the Commission and their successors such power of moderation and adjustment as will make it clearly impossible for any action to be taken by the Construction Company unfair to the companies or to the people.

In the matter of constructing the subway, the plan of contract I have prepared provides distinctly that it shall be done in accordance with the plans and specifications furnished by the Commission, and this extends to every detail, and provides for every change of plan the Commission deem advisable. It will therefore still pertain to the Commission to see that the subway is properly and honestly laid, and if it is not, the supervising authority will be responsible.

In the matter of allotment of spaces, the contract distinctly provides against partiality or monopoly.

In the matter of rentals, the contract provides that they shall be subject to revision by the commission, and so, without the connivance of the commission, no extortion is possible. And such rentals are not to be more than the cost of maintaining overhead wires, as it at present prevails.

In the matter of supervision of wires and freedom from interference, the contract provides amply and in a way that cannot be questioned.

In the matter of security from and responsibility for lawsuits, provision is also made, and it is further provided generally as to disputes between the construction and the electrical companies—as to the successors of the commission, if their term of office is allowed to expire, and as to all necessary points to be provided for.

Finally, although it is not in any way obligatory upon the Commission to provide that the city shall receive any benefit from the subway, except that of having space provided for city wires, free of charge, and the spirit of the contract is rather that where the Construction Company would receive more than a fair profit on its investment, such excess should be either its own or inure to the companies by a reduction of the rate of rental. Still, in case unusual profit should accrue to the company in any year by reason of the rental not being so reduced, it is made part of the contract that the city, the electric companies and the Construction Company shall divide all excess over ten per cent. net on the capital invested by the Construction Company.

I submit herewith the form of contract called for, which has been submitted to the Attorney-General for his official criticism, and which I am authorized to say he will officially approve if properly presented to him as from the Commission. Very respectfully, D. L. GIBBENS.

The form of contract runs thus:

This agreement, made this day of July, 1886, by and between Roswell P. Flower, Jacob Hess and Theodore Moss, as Commissioners, under and by virtue of an Act of the Legislature of the State of New York, being Chapter 499 of the Laws of 1885, passed June 13, 1885, as amended by Chapter 503 of Laws of 1886, passed May 29, 1886 (acting for themselves and for and in behalf of the Mayor, Aldermen and Commonalty of the City of New York and the People of the State of New York), parties of the first part and

company, a corporation and duly organized and existing under and by virtue of the laws of the State of New York, party of the second part,

Whereas, The said parties of the first part are authorized by said Act as amended to cause to be devised a plan for the placing under ground of all electric conductors in the City of New York, and to carry the same into operation and effect;

And whereas, The said party of the second part is willing and desirous to act as servant of said parties of the first part in carrying the purposes of said Act into effect,

Now, therefore, this Agreement witnesseth, that in consideration of the premises and of the mutual promises and agreements herein contained and of the sum of one dollar by each to each of the parties hereto in hand paid, receipt whereof is hereby acknowledged, the parties hereto agree as follows:

I.

The party of the second part agrees to furnish the capital necessary to build the subways herein contemplated, not less than million dollars, and will build, equip, maintain and operate the same as herein provided.

II.

The management of said subway and the rental of the spaces thereof shall be with the party of the second part, but such management and rental shall at all times be wholly subject to revision, alteration, amendment, and reversal by the parties of the first part and their successors, but the parties of the first part and their successors shall not interfere in such management or rental except for the purpose of more fully carrying into effect the intent of this agreement or of the laws of this State, or of the ordinances of the City of New York. And to further the intent hereof, the party of the second part shall keep in regular books for that purpose full and accurate accounts of

1st. The amount of space in said subways occupied, with the names of those so occupying it.

2d. The number and kind of electric conductors therein, with the names of the owners thereof.

3d. The gross and net amount in detail of rental and charges of all kinds collected by the party of the second part, with the names of the persons, corporation or association paying the same.

4th. All expenditures, payments and outlays of every kind (whether commissions, allowances, if any, or otherwise) made by the party of the second part, in detail, with the names of those to whom the same are made.

And said books and accounts, and all the books, papers and writings of the party of the second part, shall at all times be open to inspection by the parties of the first part and their successors, who may take full copies thereof.

III.

The subways herein contemplated shall be built by the party of the second part in accordance with the plans and specifications to be furnished by the parties of the first part, which subways shall at all times be kept in good repair by and at the cost of the party of the second part, who will adopt, subject to the approval of the parties of the first part and their successors, any and all improvements that will increase the usefulness and efficiency of the system contemplated by the act hereinabove referred to. The parties of the first part and their successors shall have at all times the right to make such modifications and changes as experience shall show to be desirable, either in the plans and specifications, the construction of the subway, the material to be used, and all other matters in connection with said construction.

IV.

The party of the second part shall, at its own cost, furnish to the parties of the first part any and all maps, working and other plans, profiles, surveys and drawings made to scale or otherwise, and all accessible data, figures and information, that may be requested by the parties of the first part, and necessary, or deemed so to be, for the purposes hereof, and shall also reimburse the parties of the first part for all expenses incurred by them in superintending and inspecting the construction of said subways.

V.

The spaces in said subways shall be leased by the party of the second part to any authorized company operating or intending to operate electrical conductors in any street, avenue, or highway in the City of New York that may apply for the same.

No space not actually needed for occupation by its electrical conductors in the due conduct of its business shall be leased to any company to the exclusion or detriment of any other company needing space in said subways and desirous and able to pay for the same.

The said party of the second part shall, without charge, supply to the City of New York all space in said subways necessary for its electric conductors and the electrical conductors of each separate department of said city.

If at any time the space in such subways shall not be sufficient for all companies so applying for the same, such space shall be provided as shall be so needed by the party of the second part at its own cost, subject to the approval of the parties of the first part, and their successors, as in the original construction.

VI.

The rent to be collected by the party of the second part from any company occupying by electrical conductors space in said subway shall not exceed the present cost of maintaining such conductors. But this shall not prevent the making of any contract between the said party of the second part and the companies operating electrical conductors on any terms which may be mutually agreed upon, subject to the approval of said parties of the first part and their successors.

The party of the second part may fix a fair scale of rents to be charged, according to the kind of conductors and the amount of space required, which rents shall be at the same rate to all occupants, and whenever the net annual rental from said subways, after paying charges and expenses, shall exceed ten per cent. of the value of the capital invested by the said party of the second part, the excess above said ten per cent. shall be paid one-third thereof to the City of New York, one-third thereof to the companies occupying said subways and paying rent therefor, pro rata, and one-third to be retained by the party of the second part.

VII.

All companies occupying space in said subways shall own their own conductors and shall have the full management and control thereof, except where otherwise mutually agreed upon by said party of the second part and said companies, subject to the approval of the said party of the first part and their successors, but said management and control shall be subject to the rights of all other occupants of said subways and to such reasonable rules and regulations as may be made by said party of the second part. All maintenance and repairs of such conductors shall be done by the company owning them, under the supervision of the party of the second part, who shall prevent injury to the conductors of other occupants, and shall guarantee safety to all.

VIII.

In case any dispute shall arise between the party of the second part and any company occupying or desiring or required to occupy said subways, the same shall be referred to the parties of the first part and their successors for settlement, whose decision shall be final.

IX.

The party of the second part shall give a bond to the parties of the first part in the penal sum of half a million dollars, with good and sufficient sureties, satisfactory to the parties of the first part, securing the just and full performance of this contract and the building of said subways as herein provided, and securing said parties of the first part and their successors against any and all patent and other suits arising from the building and operation, use and maintenance of said subways. But as the expense of compelling owners of overhead wires to enter said subways is properly one falling upon said parties of the first part, and as said expense can, with others, be collected from said owners of overhead wires, all such expense incurred in compelling said owners of overhead wires to go into said subways shall, in the first instance, be borne by said parties of the first part and their successors.

The said bond shall also be a guarantee to the city of New York for any and all damage to the said city by reason of the construction of said subway, and shall be a guarantee to said city that said party of the second part shall replace the pavements of said city and other property of said city removed in the course of said construction in the same manner and condition as before said removal, and shall in no wise injure the said pavement or other property.

X.

If at any time in the opinion of the parties of the first part, or their successors, there shall be a substantial failure by the party of the second part to fully carry out the provisions of this agreement, and it is so adjudged by competent judicial authority, the parties of the first part and their successors may enter into the possession and control of said subways and make such disposition thereof as may be lawful, and the parties of the second part shall thereupon cease to have any interest or property in such subways and will quietly and peaceably surrender the possession and control thereof to the parties of the first part and their successors.

XI.

The parties of the first part hereby grant to the party of the second part, subject to the approval of the proper officers of the City of New York, as provided in said Act of 1885, the right to build subways in accordance with such plans and specifications as shall at any time be furnished by the parties of the first part, who hereby agree to use all lawful means in their power to compel all authorized companies or persons using electrical conductors to comply with said law, and to place their conductors in said subways, and to pay a fair rental for the space occupied therein; but the parties of the first part and their successors shall not be responsible for any failure therein.

XII.

The successors of the parties of the first part shall be construed to include those who may succeed them as Commissioners prior to the first day of November, 1887, and those appointed by or under any law amending said law, or by or under any law hereafter passed by the Legislature of the State of New York, or any official of the City of New York, succeeding to the powers, or any of them, of said parties of the first part, or any other person or persons succeeding to said powers.

At the meeting of the commission on July 20, protests against the award were received from the Averill and North American companies. The form of bond for the Consolidated Company was approved. Mr. Lauterbach said that he would submit to the commission, in confidence, until the selections were made, the names of ten gentlemen who were willing to become sureties on the half-million-dollar bond. He had drawn up the form of bond and a list of 21 patents held by the company, in anticipation of the meeting of the Board of Directors. It was then agreed that the commission should meet next, to hear a report by the counsel, Mr. Gibbens, on the form of bond submitted, and that at a meeting to be held on Thursday, at 3:30 P. M., the contract should be signed, sealed and delivered. Mr. Lauterbach told the commission that his company would be ready to begin work on the construction of the subways in three weeks after the signing of the contract, and that the work could be proceeded with at the rate of of 500 feet per day. Mr. Lauterbach submitted 11 instead of 10 names, and all the commissioners said that every name was satisfactory. Five will be selected to go on the bond.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, July 19, 1886.

In an interview a day or two ago with Mr. Goff, the energetic President of the American Electric Manufacturing Company, I gleaned some highly interesting facts as to the rapid development of the American system. Running quickly over the field, Mr. Goff said :

"The happy idea of combining two standard systems (arc and incandescent) to operate from one station, furnishing either large or small lights for streets, stores or offices, at any distance from the source of power, and by separate circuits or operating from the same dynamo, as may be preferred, received a good illustration in the plant installed last spring by our company at Jacksonville, Fla. This has been in working order for several months, about fifty arc lamps doing fine work on the streets and in large stores, and 200 Edison 'Municipal' being employed in several stores and the office of the *Times-Union*, about a mile from the lighting station. In May the Citizens' Gas Company purchased this plant, and have been greatly encouraged by the results secured.

"At Saratoga, where 75 American lamps are in use, some 350 Edison lights are going in, a part on the arc circuits, with special attachments, rendering them controllable in groups of three, and of any required candle-power from 10 to 50, and a part on special wires for outside lighting.

"The Arlington Mills, at Lawrence, Mass., have recently been equipped throughout with the American arc system. A 50-light plant was first installed on a 60-days' trial, which resulted in an order for 300 lamps, which are operated from six dynamos of the latest automatic regulation. A 50-light American arc plant has been ordered for the new Washington Mills, now in process of construction in Lawrence, Mass. Then the magnificent beaches and hotels of Old Orchard, Me., are to be lighted this season by the improved American system, under the guidance of Manager F. A. Sawyer, of the Portland company. A 25-light dynamo is now in operation there.

"I think you ought to note, too, that work on fine silk fabrics can be done by a steady arc lamp as well as by daylight. The silk mills of Bamford Bros., at Paterson, N. J., have a 35-light plant from the American Electric Manufacturing Company, and it is doing good service.

"One of the most promising young electric lighting companies ever formed in this State was recently chartered in Hornellsville—'The American Illuminating Company of Hornellsville.' The officers are as follows :—President, John M. Finch, Vice-President of the Citizens' National Bank ; Vice-President, Floyd F. McConnell, of McConnell & Co., lumber ; Treasurer, Hon. J. E. B. Santee, Treasurer Citizens' National Bank ; Secretary and Superintendent, Luther T. Mason, local manager W. U. Tel. Co. The company has installed 105 lamps of the American Electric Manufacturing Company's system, and as the street lighting by 55 lamps is very effective and the commercial business rapidly increasing, it proposes to increase its capacity by adding a 35-light machine. It is also expected that from 100 to 200 Edison incandescent lamps will soon be placed on the arc circuits, and this will doubtless prove an introduction to a large growth of business.

"Asbury Park, N. J., is now lighted by 35 American arc lamps.

"There," said Mr. Goff, "that is not all, but I guess it is enough to indicate the popularity of our system and the success with which we are pushing it. If you come in again in a day or two, and like to take some more notes, I will give you many other items about new plants."

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Mass., July 19, 1886.

A new firm, Messrs. Huston, Perrin & Co., have taken offices at No. 57 Oliver street, in this city.

They are sole agents in the New England States for the Dickson Manufacturing Company, of Scranton, Pa., builders of steam engines, boilers, etc., etc.

They will make as the leading feature of their business the fitting-up and equipping of steam plants in connection with arc and incandescent electric lighting. This new enterprise ought to receive generous patronage from the electric light fraternity.

The newly incorporated electric lighting company of Waltham does not mean to disband on account of the action of the gas company directors in voting to introduce the electric light. The new company will take steps immediately to install the light.

At a meeting of the Somerville Board of Aldermen on the evening of July 13, Tuesday evening, July 27, was appointed as the date for the hearing of all persons interested in the petition of the Somerville Electric Light Company for permission to locate poles and wires through certain streets.

The stockholders of the Sun Electric Light Company, of Woburn, Mass., held a meeting at Manchester, N. H., on July 15, at which seventeen hundred and fifty shares were represented. A unanimous vote was cast to reorganize the company and to increase the capital stock to $50,000.

There are many attractive and imposing buildings in this city which are fitted throughout with electric lighting apparatus and electrical connections ; but most noteworthy is the Mass. Hospital Life Insurance Company's new building on State street. This magnificent edifice occupies a central location, and is really one of the most palatial office blocks in the city. The appointments of the building include all of the latest improvements in heating, lighting and ventilating apparatus. In the basement is a large fan-blower, which in the winter sends a current of warm, and in the summer of cold, air through the corridors. The first and second floors are heated by steam by both the direct and indirect methods, and the other floors only by the direct method. All of the rooms are provided with the thermostats of the National Electric Service Company, to regulate temperature. To each gas jet there is attached an electric light, enabling the occupants to take their choice of lights. The electricity is furnished by three dynamos in the basement. The Edison Company for Isolated Lighting of Boston (Messrs. Paine & Francis) furnished the entire electric lighting equipment, and the New England Wiring Company, of this city, had charge of the placing and connecting of the wires. The building is now practically complete, but will not be ready for occupancy till August.

The Charlestown Gas Company has ordered from the Brush Electric Company, of Cleveland, O., a complete arc light outfit, and has begun installation of the necessary equipment for a large electric light plant.

The Merchants' Electric Light and Power Company, of this city, has purchased several of the distributing boxes manufactured by the Sun Electric Light Company, of Woburn, Mass., to be used for incandescent lighting off an arc-light circuit.

Bell Telephone stock took another upward movement on Saturday, 17th, advancing from 205½ to 208. It is the prevailing conviction here that the reaction from 225, the highest figure touched last week, is only temporary, and that the stock is soon going much higher than that.

Mr. J. H. Howard, who controls Volta-Pavia rights for foreign countries has arranged with Messrs. Leon N. Loeb and James Saml. Burroughes, of London, England, who are at present on a short business visit to this country, for the exclusive control of all Volta-Pavia patents (nine in number) for Great Britain, where a large company of £100,000 capital is to be floated on their return to London, where arrangements to do business on a large scale are already completed. Mr. Burroughes, of the extensive firm of Burroughes & Watts (the largest billiard table makers in the world) will be chairman in the English company. Messrs. Loeb & Burroughes will handle the Volta-Pavia rights in all European countries.

The Thomson-Houston Electric Company has just organized new local electric lighting companies in St. Paul, Minn., and Bangor, Me., the former to use 60 arc-lights and the latter 300 incandescents. The Manchester Gas Company, at Manchester, N. H., has incorporated an electric light company, composed of its own officers, and has ordered of the Thomson-Houston Electric Company dynamos and lamps sufficient for sixty arc lights. Electric light plants at Sacramento, Cal., and Charlotte, N. C., which have been using the Thomson-Houston system for some time, have each ordered additional machines, lamps, etc., for 45 arc-lights. The Thomson-Houston International Electric Company recently organized an electric lighting company in Paris, France, and quite a number of commercial lights have already been furnished.

In a recent interview with Mr. Wm. Whitney Munroe, of the Thomson-Houston Electric Company, my interlocutor gave me his views regarding the advantages of gas companies over local electric light companies in the operation of central station plants. "There are no people in the world," he said, "who can produce electric lights as cheaply as gas companies, for they possess many facilities which renders this possible. A local electric light company entering the field assumes outlays and expenses which would be avoided by the majority of gas companies. For instance, the electric light company must purchase land and erect suitable buildings thereon. They must employ a superintendent who commands a fair salary; they also are obliged to pay the current rates for fuel, whereas a gas company already own the land, and in the majority of cases the building in which to locate the plant. They have in their employ a superintendent who would be thoroughly capable and able to superintend the electric lighting station without additional cost to his company, and without any increased demand upon his time. Another very important advantage is the ability of a gas company to utilize all its waste fuel—coke, breeze, screenings, etc., etc. All these advantages tend, as I say, to enable gas companies to produce electric lights at a cost far below that possible by any local electric light company.

"During the five and a half years I have been interested in electric lighting, it has always appeared singular to me that the gas companies should fail to view the question in this light. As a result of their lack of appreciation of the extent to which electric lighting would be developed, local electric lighting companies have been established in all parts of this country, and they have become flourishing and paying enterprises. I do not mean to say for a moment that electric lighting can or ever will impair the interests of the gas companies; on the contrary, my experience leaves me in no doubt that a first-class system of electric lighting successfully introduced into a city will tend to increase the consumption of gas invariably. This is easily explained from the fact that it educates the eye up to a high standard of illumination and consequently the general interests of the gas companies are promoted.

"The consumption of gas is thus increased in many ways. I think it is a fact that at least a very large proportion of the gas in any city is consumed in private houses; there, while individually the gas bills may be small, the consumption is steady and constant all through the year, and in the aggregate it constitutes a very large proportion of the gas companies' source of revenue. Let a local electric light company enter the field, and while they may and will secure the lighting of the most prominent stores and streets, the more lights they install in the field the greater will be the consumption of gas in the private section of that city; while there will always be a fair percentage of the storekeepers who will adhere to gas, and who, in order to vie with their business competitors in brilliant illumination of their stores, will quadruple their consumption of gas. I have conversed with many officers of gas companies who have noted carefully the progress that electric lighting is making, and I have yet to find one who will deny the fact that their revenues and profits have largely increased since the introduction of electric lights. It is an interesting fact that there is a general movement in gas circles to consider the advisability of operating electric lights in connection with their gas works, and I am now in direct communication with a large number of gas companies who propose combining gas and electricity in their future business operations.

"It occurs to me that the best course for a gas company to pursue in entering the field of electric lighting is not to do so as a gas company, but as an independent corporation. They should form a separate organization which, while it comprised strictly directors and stockholders in the gas company, should still operate under its own charter rights as an electric light company. In many communities there is a strong prejudice existing against gas companies; the public is inclined to think that the gas companies have had a monopoly, and should the gas people come out openly as a gas company to operate electric lights, it is liable to create the impression that it is an attempt to close out the field against all legitimate competition, and thereby maintain high prices for artificial illumination. Thus, in the case of the Manchester Gas Light Company, composed of gentlemen well known for their conservative and shrewd business management, which has placed them among the richest gas companies in the country, after thorough and careful investigation and satisfying themselves that the time had arrived when they should place themselves in position to furnish electric lights to their patrons, they met as a gas company and organized the Ben Franklin Electric Light and Power Company—were duly incorporated under that title and will energetically proscute the business as such, furnishing the lights at a reasonable and fair price to all parties and not attempting to underbid the competitive Electric Light Company which has been in the field there for a number of years past. This action on the part of the Manchester Gas Company has created a very favorable impression among the public, as showing their good faith in the undertaking, and their disposition to furnish a superior system of electric lighting on an equitable and fair basis. Now, I anticipate this result in Manchester ; the Ben Franklin Electric Light Company will undoubtedly establish a flourishing business, but in no way will they conflict with or impair the general interests of the gas company. On the contrary, the future will develop a steady increase in the consumption of gas, so that both the electric light and the gas company will reap the full benefit of this liberal and progressive policy, while the public in general will be greatly benefited by much better service of artificial illumination, without fear of disastrous competition and conflicting interests which would eventually result in the extinction of one party and a return to high prices by the successful competitor. The course adopted by the Manchester Gas Company is one which commends itself to all in the business, and, to my mind, is the only successful one for them to pursue."

W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, July 17, 1886.

It looks as though, after all the talk and bluster of the City Council and chronic grumblers to the contrary, that the Central Union Company would furnish all the telephone service Indianapolis is likely to have for some time to come. The Co-operative (Wallace) Company succeeded in having part of its charter modified at the last session of the City Council, though the Board of Aldermen failed to take any action. At present the new company's affairs seem to be somewhat mixed, one man having been elected a director without having known anything of it previous to the notification of his election.

Mr. Wallace says there's no way to prevent their putting his instruments in use, while Supt. Hockett, of the Central Union, says that the Bell people have an injunction against them in New York now, which prevents their use.

The Brown Telephone Company has petitioned Evansville for the right of way in that city, to take the place of the expelled Cumberland Company. The District Telegraph Company has been granted the privilege of putting telephones in the city departments for experimental purposes.

The Kokomo, Ind., Electric Light and Power Company has been incorporated with a capital stock of $6,500 and A. T. Comstock, Charles A. Jay, J. O. Henderson, James B. Parker and J. D. K. Kennedy as directors.

The Kokomo Company will use the Thomson-Houston system.

The Municipal Electrical Lighting and Construction Company, of Minneapolis, has just contracted for the electric work in the Boston Block, including wiring for six hundred incandescent lights.

I give the following copy of the contents of a letter lately received by me. It carries its own comment, and is given here for the benefit of that occasional rarity who does not believe in advertising : "Would you please inform me who makes the telephone switch-board called the —— board, and oblige us? We have looked through your paper several times, but the parties making the board do not seem to advertise."

Mr. H. Ward Leonard, the active general superintendent of the company, gives me the following facts in regard to plants installed by the Western Edison Light Company : We have up to date installed about 150 plants ranging in size from 25 lights to 2,000 lights. We have now in process of installation 11 plants, three of which are central stations, in Oskaloosa and Ottumwa, Iowa, and Neenah, Wis. Among the larger isolated plants at present being installed are the following : Northwestern Mutual Life Insurance Building, Milwaukee, 1,800 lights ; Southern Insane Hospital, Anna, Ill., 700 lights ; C., M. & St. P. R. R. passenger depot, Milwaukee, 600 lights ; State Penitentiary, Ft. Madison, Iowa, 600 lights; Woodruff Hotel, Chicago, 300 lights. We are now about lighting by the Edison system the first mine lighted by incandescendent lights in the United States. It is that of the Milwaukee Cement Company, and is but a short distance out of Milwaukee. The work is very similar to that of coal mining. A plant of 75 lights will be used. The central stations will be of the following capacities rated in 10 candle-power lamps : Oskaloosa, Iowa, 2,000 ; Ottumwa, Iowa, 1,200 ; Neenah, Wis., 700 lights. We will install very shortly central stations in a large number of other places, some ten or twelve towns being at present about ready to close contracts. We are receiving very flattering statements as regards economy of our system, and particularly in regard to life of lamps. At the State penitentiary at Anamosa, Iowa, one convict puts his entire attention to keeping a set of books showing life of lamps on our plant there. They have a plant of 325 sixteen c.-p. lamps. We receive monthly statements from them showing the economy of the plant. Each socket is numbered. When a new lamp is placed in a socket it is charged with 600 hours on the books; then every hour it runs is credited to it. At the end of the month the account shows the amount of saving effected beyond 600 hours. The summary of the statements the last six months shows that they break 24 lamps per month less than would be broken if the lamps averaged only 600 hours. Thus they save $20 per month on the breakage of lamps above our guarantee. The lamps are kept at exactly 16 candle-power, and have careful attention. A detailed statement of the month of June shows a production of that month of 21,898 lamp hours and a breakage of 10 lamps, of which 6 had the glass ulbs accidentally brok en, and 4 were burned out normally. The

actual life of each lamp as given in the statement and the average of these which were burned out normally show 2,181 hours. The life of these which had the bulbs accidentally broken was 1,822 hours, giving the average life of the entire 10 which we replaced 1,966 hours. The statement also shows that the 325 lamps connected on the circuit at the end of June had each burned an average of 1,358 hours. The life of some of the individual lamps is extraordinarily high. About one-half of them last 2,000 hours, and a very large number last 4,000 hours. One particular instance deserves attention. It is a lamp which burns 10 hours a day. It had already burned 7,023 hours upon June 30, and was still burning. This is the longest life of an incandescent lamp we have ever seen quoted burning at candle power. In the tunnels in Chicago we have 300 sixteen candle-power lamps which burn continually night and day. The lamp is never touched from the time it is placed in a socket until it breaks. And the actual life of some of these lamps is indeed as long as that above instanced; but as there is no such exact and perfect record kept, it is not so definitely certain. In the tunnels 256 lamps burn continually, night and day, and 40 more lamps burn 12 hours a day, making a total of 200,000 lamp hours per month as the production of light in the tunnels. During the six months beginning Dec. 1, the average breakage per month was 62 lamps, giving an average life during that period of 3,225 hours. Upon realizing this extraordinary length of life, the city authorities concluded they could have more light and less life from the lamps, and they were accordingly set to run at 21 candles, since which time the life is shown to be about 1,500 hours. There is no place where a more positive record of life can be had than in these tunnels, as the lamps burn continuously, and there is no question as to how many hours they burn. A recent test on a 250-light plant in C. H. Slack's grocery store in this city showed between 9 and 10 lamps per horse-power delivered to the dynamo. We only guaranteed 8. In our central stations the use of motors is coming forward prominently now, and a large demand for them has made it almost impossible for us to keep up with orders received. We use the Sprague motor almost altogether. In a few instances, for very light work we use a motor manufactured by Bergmann & Co. A recent novel application of our light was made at Waukesha, Wis., in the Arcadian Springs. The spring is a very large and beautiful one, having a diameter of 4 feet and a depth of 12 feet. An Edison lamp was placed at the bottom of this spring, and it burns there continually. The effect is very striking, and causes favorable comment. We have several plants which are operating through submarine cables.

We are now contemplating the introduction of the Edison municipal system on a large scale. The system has now arrived at a standard condition, and results from its use are entirely satisfactory. By its use incandescent lamps may be lighted on a six-mile circuit by means of a No. 12 wire with a loss of only 5 per cent in the conductors. The lamps are independent of each other, and are giving excellent results in some half a dozen large installations in prominent cities; among others, Lawrence, Mass., Denver, Col. and Lockport, N. Y. To show the cost of production by this system, and its facility for lighting towns, we will merely state that at Cincinnati the Edison Company has made a proposal to the city to supplant every gas and oil lamp at present in operation there for street lighting, by a 16 candle Edison lamp, operating the entire plant for one half the cost of their gas per year used for that purpose. The city was getting this gas for $1.12, so that the offer of the Edison Company was equivalent to supplying gas at 56 cents per 1000 feet. This offer is at present being discusssed by the Cincinnati authorities.

Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes the following stock quotations:

Bell of Mo.	$147@$150
Chicago	365@ 375
Central Union	45@ 47
Colorado	18@ 20
Cumberland	65@ 70
East Tennessee	175@ 180
Great Southern	30@ 32
Great Southern Scrip, 90 cents on the dollar.	
Iowa Union	15@ 18
Michigan	63@ 65
Mo. & Kan.	55@ 57
Mo. & Kan. Scrip, 55 cents on the dollar.	
Rocky Mountain Bell	40@ 45
United	15@ 17
Wisconsin	103@ 105

W. A. K.

THE TELEGRAPH.

Pleasing the Frenchmen.—The New York *Herald* of the 18th inst. published two columns of special dispatch from Havre showing that the merchants there are well pleased, as they have good reason to be, with the quick and accurate work of the Commercial Cable Company.

Stock Exchange Tickers.—Argument was heard by Judge Barrett, in the Supreme Court Chambers, last week, on the motion for the continuance of an injunction restraining the Stock Exchange from excluding the Commercial Telegram Company from keeping its "tickers" on the floor of the Exchange and sending quotations therefrom. Ex-Senator Roscoe Conkling argued that the Commercial Telegram Company had a contract with the Stock Exchange. James C. Carter contended that the company merely had a privilege which was terminable at the will of the Exchange. Judge Barrett reserved his decision.

THE TELEPHONE.

Cincinnati, O.—The Western Electric Company, Chicago, has secured the order of the City & Suburban Telegraph Association of Cincinnati for ten multiple switch-boards, having a present equipment of 2,000 lines and a total capacity of 5,000.

A Row at Elmira, N. Y.—Trouble has occurred at Elmira between the city authorities and the New York and Pennsylvania Telephone Company as to an increase in the supply of free telephones to the city. The council threatens all manner of horrible things, but the company keeps a stiff upper lip.

"A Shameful Conspiracy."—This is what the Washington *Post* calls the rejection of Mr. Goode as Solicitor General by the U. S. Senate. It alleges that Senator Mahone and the American Bell Telephone Company are responsible for Mr. Goode's discomfiture. The paper had a sensational leader on the subject.

Sour Grapes.—Now that the Cumberland Telephone Company is taking its telephones out of Evansville, Ind., one of the local papers remarks: "Many and scores of merchants say they are glad the telephone has been taken out. In many ways it was a nuisance, and if the oaths that have been uttered against it in the past year have to be atoned for, the fires of hell will be dampened for years by the tears of those who were led to sin through its soul-destroying influences."

The St. Louis Meeting.—In his last circular, Secy. Barney says: Arrangements have been perfected by the secretary whereby delegates from New York, and those passing through this city, will be transported to and from St. Louis at a greatly reduced rate. Full details concerning the trip may be obtained by applying to him, either in person or by letter. The following reduced rates have been obtained for members of the convention, from the Southern Hotel: per day, on the American plan, for inside rooms, $3.00; for outside rooms, $3.50; for rooms with bath, $4.00; for rooms on parlor floor, $5.00. Vice-President Geo. F. Durant, General Manager of the Bell Telephone Co. at St. Louis, writes that he will be glad to secure rooms for delegates and exhibitors, upon request being made to him.

Brooklyn's Police Telephone System.—Supt. F. C. Mason, of the Police Telegraph Department of Brooklyn, naturally takes pride in the efficient service rendered to the city by his office. The local papers have lately called attention to the fact that Brooklyn already has, under his care, a police telephone system similar to that now proposed for New York, supplementary of the dial telegraph. There can be no question that with the improvements effected by Mr. Mason, the Brooklyn system is very useful. "This branch of police business is about as near perfect as it can be. The New Yorkers may cling to dials and one word a minute transmissions, but Brooklyn will hang on to the telephone and be as far ahead of the metropolis as day is brighter than night."

THE ELECTRIC LIGHT.

The Brush Electric Company, of Cleveland, is doing the best summer business it has had for several years. The works are crowded with orders, and the management is compelled to run some of the departments on double turn.

The New Holloway College, at Egham, Eng., is about to be lighted with incandescent lamps; over 500 Edison 16 c.-p. lamps will be used. The current will be obtained from two Edison-Hopkinson dynamos, each of 500-light power.

Denver, Col.—The meeting of the American Society of Civil Engineers was held in Denver this month. Many of the members took interest in the electric railway, and there was a very general approval of the application of the Edison system to the lighting of the streets.

New Lots, Long Island.—The New Lots Electric Light Company is having a heap of trouble. It was organized over a year ago, and the minority claim that the majority have formed a combination to freeze them out. A law suit will soon be started to define their rights, and it is said that some of the town officials will be shown up in a peculiar light.—*Brooklyn Union*.

Detroit Aldermen.—A dispatch of July 16 from Detroit says: The trial of Thomas Manning, ex-Alderman, for bribery, resulted this evening in a verdict of not guilty. Manning was charged with having offered Councilman Raynor $1,000 for his vote in favor of the Brush Electric Light Company, when a contract for lighting the city was under consideration two years ago.

Trouve's Hand Lamp.—While in Paris lately, President Purroy, of the New York Fire Department, saw Trouve's electric hand-lamp, and was so pleased with it that he brought one back with him. It is now being tried by the Fire Department for use in smoky fires, and when slightly modified by Mr. J. Elliott Smith, will probably be adopted to some extent.

Delaware.—The Delaware Electric Light and Power Manufacturing Company has been incorporated at Wilmington, Del., with a capital of $20,000. The officers are as follows: President, Preston Lea; secretary and treasurer, W. S. Heger; directors, C. C. Febiger, L. C. Vandergrift, C. M. Curtis, Preston Lea and W. S. Heger. The company is now installing an Edison plant at Middletown, Del.

The Silvey Company.—At Cincinnati, on July 14, the Silvey Electric Light and Motor Company was organized to operate under the patents of W. L. Silvey. The stockholders are J. E. Mooney, of the American Oak Leather Company; John E. Bell, Lane & Bodley, George B. Kerper, S. M. Lamont, P. Crosley, W. L. Silvey, G. M. Roe and R. W. Criswell. The apparatus, dynamos, motors, etc., will be made by Lane & Bodley. It is said that the organization promises a new and important industry for Cincinnati.

Costigan's Costly Moving.—John Costigan, of Jersey City, obtained a permit from the city a few days ago to move a two-story frame dwelling. He intended to move it through Newark avenue, but the Jersey City and Bergen Horse Railroad Company enjoined him, and he was obliged to change his plans. By his new plan he crossed Erie street with the house, and all day on Friday last the Erie street horse cars were blockaded. The Erie street line is owned by the Jersey City and Bergen Horse Car Company. On Friday night the laborers made their hauling tackle fast to one of the telegraph poles. The strain was so great that the pole leaned over and several of the wires broke, falling upon the Electric Light Company's wires. The circuit was thus broken, and forty-one electric lights in the principal streets were extinguished. The accident caused the partial destruction of the dynamo. Mr. Costigan is threatened with suits for damages, both by the Electric Light Company and the Horse Car Company.

APPLICATIONS OF POWER.

Winthrop, Mass.—The electric railway is to be built at once. It is in good hands. The Boston *Globe* says: "The cost for construction, repairs and operating expenses owing to the nature of the same will be exceedingly light, and the gentlemen at the head of the enterprise, all men of business reliability, have demonstrated that allowing no increase whatever over the number of people carried by the omnibuses of the present time, they will be able to earn a handsome dividend upon the capitalization of the company."

PERSONALS.

Dr. Norvin Green has, we hear, accepted the Vice-Presidency of the American Exposition to be held in London next year. The Hon. E. B. Washburn is the President.

Mr. Ernest Danvers has resigned his position as Inspector-General of Colombian Telegraphs and has removed to Caraccas, Venezuela, where information can be obtained from him.

Mr. Henry C. Hyde, of the Guatemala Telephone Company, San Francisco, has secured the contract for the Volta-Pavia system for California, and returns home at once to start the business.

Mr. Cyrus Field, according to the reports of the hearing given in the London *Electrician*, has very successfully cleared himself of the charges brought against him in London *Truth* relative to Wabash stock. The libel suit has stopped, Mr. Labouchere withdrawing his imputations.

Mr. Joseph Wetzler, of THE ELECTRICAL WORLD editorial staff, has been appointed by the President of the Institute a member of the Board of Examiners of the American Institute of Electrical Engineers. Mr. G. A. Hamilton is chairman of the board, whose other members are Mr. W. D. Sargent, Dr. S. M. Plush and Prof. C. A. Young.

Prof. H. S. Carhart.—The many friends of Prof. H. S. Carhart and of the Northwestern University, have heard with the deepest regret that he has accepted a position in the State University at Ann Arbor, Mich. To say that the University and the community sustain a severe loss in his removal is a very mild way of stating the case. It will not be easy to find nor keep one whose scholarly reputation and whose professional enthusiasm combine to make him a power in any institution of learning. The best wishes of his personal friends and of the friends of sound learning follow him to his promising and enlarged field of labor. He will fill the chair of physics there, and his election to the position was unanimous.—*Evanston (Ill.) Index*.

MISCELLANEOUS NOTES.

Electro-Photography.—M. Tommasi has found that the silent electric discharge produces the same effect upon sensitive photographic plates as do the ultra-violet and violet rays of light.

The Cowles Process in Mexico.—The Mexican *Diario Official* publishes a decree granting an exclusive privilege for ten years to Messrs. E. H. & A. H. Cowles for their process of reducing metals by electricity.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—B. & M., b 2, a 3; Western Union, b 66⅛, a 66⅝.

Telephone.—Am. Bell, b 209, a 210; Erie, b 28, a 28⅛; New England, b 39, a 39¼; Mexican, b 1¼.

The Boston *Herald* of July 16 says: "Bell telephone came down like a stick from its skyrocket ascension of yesterday, 225 and 207¾ being yesterday's highest and to-day's lowest prices. Some said it was a natural reaction, and that the management was bluffing when it said no rights were to issue on account of the long-distance company. Others said bulls on the stock were meeting the just fruits of too much knowledge, or rather an assumption of knowledge. As it appears for the moment, the extra dividend plums of the year have all been harvested, and no rights are to issue. Meanwhile the company will go on earning over 20 per cent. on its capital, and, no doubt, steadily increasing the amount, unless legislation shall interfere. Earnings like this always invite adverse legislation, and it was unfortunate for American Bell that it could not obtain a larger capital to spread its earnings over. Its present earnings would look smaller on twice its present capital of $10,000,000."

Electric Light.—Edison, b 120, a 125.

BUSINESS NOTICES.

Holmes, Booth & Haydens have issued a handy table of the maximum safe carrying capacity of bare copper wire, arranged by Mr. H. Ward Leonard, and accompanied by a diagram showing the curve of said maximum. The table is very useful for reference. The article by Mr. Leonard in our columns this week deals with the same subject at greater length.

Volta-Pavia.—We have received a large printed sheet, 20 × 25 inches, issued by the Chemical Electric Light and Power Co., setting forth the construction and directions for use of their "Volta-Pavia" primary battery for electric lighting, the operating of motors and other purposes. On the reverse is a comparative table showing the composition, E. M. F., etc., of the principal forms of batteries in use at present. The table is quite a handy one. Special note should be made of the announcement of the company in this week's advertising columns, page vii.

Mr. Curt W. Meyer, of No. 357 Fourth avenue, this city, manufacturer of the well-known Curt battery, has just issued a profusely illustrated catalogue and price-list of electro-medical, optical, physical and chemical apparatus. The list of electrical apparatus is very complete, and contains many appliances, such as throat illuminators, batteries, magnets, static machines, induction coils, incandescent lamps, electro-motors, Geissler tubes, electric bells, annunciators, etc., making altogether a very complete list. The catalogue embraces 64 pages, large 8vo, and the illustrations are very good.

Hale's Honey,
The great cough, throat and lung cure, 25c., 50c. and $1.
GLENN'S SULPHUR SOAP heals—beautifies the skin; 25c.
GERMAN CORN REMOVER kills corns and bunions; 25c.
HILL'S HAIR AND WHISKER DYE, black and brown; 50c.
PIKE'S TOOTHACHE DROPS will cure in one minute; 25c.
DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED JULY 6, 1886.

344,818. Induction Coil; Daniel Drawbaugh, Eberly's Mill, Pa., Assignor to the People's Telephone Company, New York, N. Y. It has two or more cores placed end to end, but out of contact.

344,823. Insulating Material for Wires; John Fottrell, Philadelphia, Pa. Consists of linseed oil, lead shavings, oxide of zinc, Venetian turpentine, gum copal and gum sandarac.

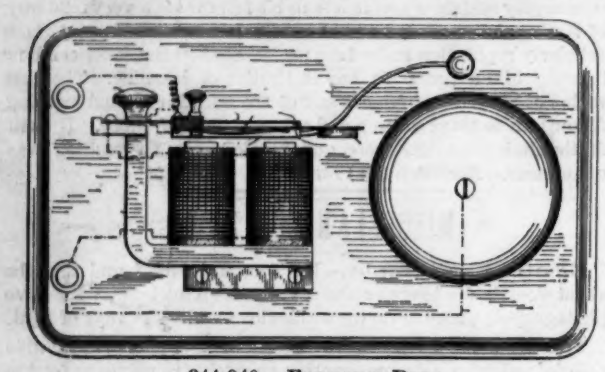
344,827. Conduit; John Grant, Omaha, Neb. The leading claim is, the combination of a conduit, electric wires contained therein, and a packing surrounding said wires, and consisting of rosin applied in a liquid state.

344,843. Conduit; Ronald McDonald, Brooklyn, N. Y. Consists of a series of superposed sections, each composed of two parallel half-sections united by tongues and grooves and having longitudinal channels, a sheathing of sheet metal inclosing the sections, an inverted trough-shaped box placed over the sheathing and inclosing the sections at the top and sides, a continuous board placed under the entire length of the sections, and a longitudinal series of stone slabs placed upon the box.

344,882. Electrodes of Secondary Batteries; Sylvanus L. Trippe, Denver, Col. They are composed of lead, zinc and silver. The zinc is withdrawn from the mixture by molecular action, and the lead oxidized in the presence of the silver.

344,938. Telephone; Sigmund Bergmann, New York, N. Y. Between platinum foil is placed a filling of carbon particles, the sides of the containing box being made of flexible material.

344,940. Electric Bell; Elliott Carhart, Brooklyn, N. Y. Consists, as shown in illustration, of two terminals located



344,940. ELECTRIC BELL.

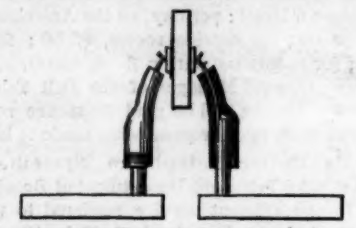
upon an operating armature elastically connected to each other, the one being rigidly connected to the striker and the other similarly to a weight, so that in operating the circuit is not broken until the instant at which the striker comes in contact with the bell.

344,946, 344,948. Galvanic Battery; George F. De Solome, New York, N. Y., Assignor to J. Seaver Page, same place

1. Consists of alternately-arranged battery elements, two pole-pieces having laterally-projecting arms for supporting the elements, arranged at different heights, the arms of one pole-piece overlapping those of the other, and a connection between the pole-pieces to prevent their spreading.

2. Consists of a main electric current and two branch circuits connected therewith, and each containing an electric battery, a circuit-breaker controlling the connection of the branch circuits with the main circuit, two electro-magnets of different powers arranged in the branch circuits, and an armature capable of movement in opposite directions by the electro-magnets and controlling the circuit-breaker.

344,957. Secondary Battery; Stephen Farbaky and Stefen Schenck, Schemnitz, Aus.-Hungary. The negative elec



345,209. CONTACT FINGER FOR VIBRATING REEDS.

trode is provided with litharge and pumice stone, and the positive with litharge, minium, coke and sulphuric acid.

344,962. Conduit; Robert L. Harris, Brooklyn, N. Y. Consists of two or more longitudinal electric conductors, and a hollow metallic conduit having a longitudinal slot in the upper part, and the interior thereof, including the faces of the slots, covered with an insulating material, and upon which insulating material the conductors are affixed.

344,983. Telephone; Arthur M. Phelps, Seabrook, Md. Consists of a telephone provided with a diaphragm having a small soft iron core or bar attached endwise to the centre of said diaphragm; and it further consists in holding the bar loosely within a central opening formed in a wire spool, and placing a dividing-sheet between the enlarged ends of the core and permanent magnet.

345,008. Incandescent Lamp; Jean T. Van Gestel, Hartford, Conn. Consists in a lamp bulb or globe having within the neck a ring of non-conducting material that supports the contact-plates in connection with the conductors of the lamp, and in the combination of such devices with the springs of the switch and a key bearing a loose sleeve of non-conducting material.

345,084, 345,085. Transmitting Articulate Sounds to Distant Points; Edward S. Spaulding, New York, N. Y. See editorial paragraph.

345,124. Secondary Battery; Alexander L. De Virloy, Edmond Commelin and Gabriel Bailhache, Paris, France, Assignors of one quarter to Leopold De Bousignac, of same place. Employs electrolyte of zinc, potash and potassic sulphate. The carbon plate is covered with cupric hydrate.

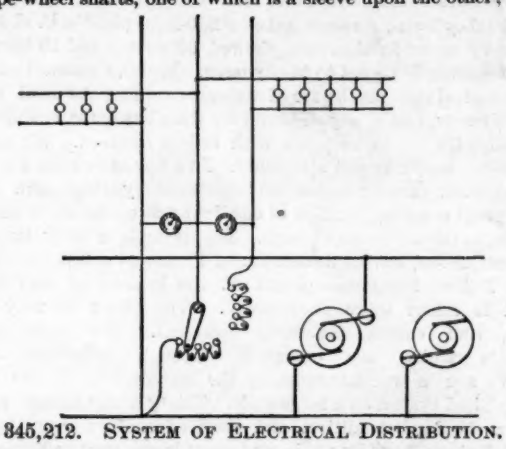
345,178. Electric Chain Battery; Robert N. Rockwell, Peabody, Kan. Numerous minute cells are secured together by flexible connections, the whole to be employed as a belt for th

body. The improvement relates to details of mechanical construction.

345,209. Contact Finger for Vibrating Reeds; Robert G. Brown, Brooklyn, Assignor to the Standard Multiplex-Telegraph Co., New York, N. Y. As combined with the yielding contact finger an elastic or rubber material, as shown in the cut.

345,212. Electrical Distribution; Harry M. Byllesby' Roselle, N. J., Assignor to George Westinghouse, Jr., Pittsburgh, Pa. Consists of a source of electricity and supply-conductors leading therefrom, a normally-disconnected conductor and two groups of translating devices respectively included between the supply-conductors and the normally disconnected conductor, as shown in the cut. A modification includes automatic means for varying the resistances shown. The object is to provide means for supplying electric currents of the required character to different translating devices, located at different points, and to economize in the construction of the plant by reducing as much as possible the amount of conductors required.

345,245. Printing Telegraph; Henry Mabnken, New York, N. Y. Consists in connecting a pallet directly with the armature of the type-wheel magnet, and pivoting the armature and pallet longitudinally of the pallet and transversely with reference to the armature, so that the pallet will swing laterally across the periphery of the scape-wheel. This laterally-swinging pallet can be used in connection with one scape-wheel fixed rigidly to a type-wheel shaft carrying one or two type-wheels, as in well-known types of printers; or it can work across two scape-wheels arranged side by side and fixed upon separate type-wheel shafts, one of which is a sleeve upon the other; or it



345,212. SYSTEM OF ELECTRICAL DISTRIBUTION.

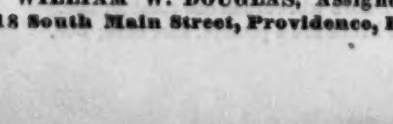
can be employed to control a single scape-wheel connected to two type-wheel shafts by pawls and ratchets.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patent issued since 1866—can be had from this office for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, New York.

George H. Pride, Electrician, Telegraph Engineer and Contractor. 9 Dey Street, New York.

William Marshall, Mfr. of Elec. Condensers. Standards a Specialty. Rooms 2 and 4 University Building, cor. Waverley and University Places, N. Y.

SHORTHAND Writing *thoroughly taught* by mail or personally. Situations procured all pupils when competent. Send for circular. **W. C. CHAFFEE,** Oswego, N. Y.


Short-hand Lesson Sheets,
For Self Instruction.
A complete Reporter in 12 Easy Lessons.
$1. Close & Black, Pub. 1338 Chestnut St., Phila., Pa.

Telephone Stocks
Of all the Different Companies
BOUGHT AND SOLD ON COMMISSION.
ALSO
Chicago Local Stocks and Bonds.
S. G. LYNCH, 146 La Salle St., Chicago.

Assignee's Sale
OF MACHINERY FOR
WORKING RUBBER AND INSULATED WIRE, ETC.

Will be sold at Public Auction, at 12 o'clock noon, on MONDAY, 26th day of July, A. D. 1886, on the premises lately occupied by the Commercial Insulated Wire and Cable Company, at Cranston Print Works, Cranston, Rhode Island—

The Entire Plant and Property of said Company, consisting of a Cruikshank Steam Engine, 50 h. p., with driving pulleys and jack gear, one 18x54 three-roll Calender, three 15x36 grinders or mills, one 15x24 cracker or washer.

The above in complete running order, set with 50 feet 5 inch shafting, couplings, hangers, bearings, etc., etc., connecting the same; 3 Tubing machines, with dies; 1 Pratt & Whitney Wire Coiling machine; 1 No. 72 R. I. Braiding machine; 1 Winding machine; 2 Parry Sifting machines; 1 54-inch steel Vulcanizer, 13 feet long, with track and car; set of Cable machinery, consisting of 1 Cutter, with reels, tables and rolls; 1 Vulcanizer 185 feet long, internal tube 4 inches, external 7 in diameter, with supports, steam pipes, thermometers, etc.; complete to operate under Eddy patents; various small machines and tools adapted for use in working Rubber; 1 100-cup Leclanché Battery; 1 Thompson Astatic Reflecting Galvanometer and Battery, complete with shelf; stock and materials on hand, consisting of washed and dried Para Rubber, and other supplies. Patents for machinery for producing Insulated Wire, Rubber Tubing, etc.

The above property will be offered for sale in one lot if a satisfactory bid is made, if not the whole will be at once put up in detail to be sold without reserve. Terms at sale For further information or view of the property, apply to

WILLIAM W. DOUGLAS, Assignee,
18 South Main Street, Providence, R. I.

THE GAMEWELL FIRE ALARM TELEGRAPH CO.,
No. 1½ Barclay St., New York. 27 Federal St., Boston. 118 La Salle St., Chicago.
"OLD AND ONLY RELIABLE" FIRE ALARM AND POLICE TELEGRAPH.
IN USE BY OVER 200 CITIES.
JOSEPH W. STOVER, Boston, President. D. H. BATES, New York, Second Vice-Pres.
CHESTER H. POND, New York, First Vice-Pres. and Sec. OTIS T. PETEE, Boston, Treas.
J. N. GAMEWELL, New York, General Superintendent.
SEND FOR NEW CATALOGUE.

STANDARD
Electrical Test Instruments.
Galvanometers, Resistance Coils, Condensers, Keys, Switches, &c., Bailey Combination Set, Pratt's Speed Indicator, &c.
Electric Mfg. Co., Troy, N. Y.
OFFICE, 311 RIVER STREET.

WANTED.

A first-class glass-blower familiar with incandescent lamp making, carbonizing and the construction of mercury pumps. Address
G. T. M.,
Care of THE ELECTRICAL WORLD, New York.

NOTICE.

Sealed proposals will be received at the office of the Board of Trustees of the Toledo Insane Asylum, Room No. 18, St. Clair Building, City of Toledo, Ohio, until August 2, 1886, at 12 o'clock M., for furnishing and putting in place al the machinery and apparatus, including engines, dynamos, lamps, conductors, switches, regulators, and all other fixtures and appliances required for successfully lighting the asylum buildings by incandescent electric light. Parties will accompany their bids with plans and specifications fully setting forth and explaining, in detail, the system of electric lighting proposed to be furnished by them. Drawings and plans of the site and of the several buildings to be lighted can be seen at the office above named.

The Board of Trustees reserve the right to reject any or all bids and waive defects. Appropriation, $18,000.

J. W. NELSON,
President of Board of Trustees.
WALTER PICKENS,
Secretary.
TOLEDO, O., July 2, 1886.

F. G. ROBINSON,
66 Beaver St., Albany, N. Y.,
Contractor for Fitting Hotels and Residences with the Latest Electrical Appliances.
Experimental Work and Manufacturer of Patented Electrical Goods.

SEBASTIAN, MAY & CO.'S
IMPROVED $60
Screw Cutting Lathe.
Designed especially for electricians and others requiring a lathe for accurate work.
Catalogue of Lathes, Drill Presses, Tools, etc., mailed on application.
LATHES ON TRIAL.
163 W. Second St., Cincinnati, O.

SPECIAL NOTICE.

National Electric Light Association.

SEMI-ANNUAL MEETING.

The Fourth Meeting—Semi-Annual—of the National Electric Light Association will be held at Detroit, Mich., on Tuesday, Aug. 31 next, at 10 o'clock A. M.

Dues being payable in advance, all members are required to forward the same for the year 1886, by check or otherwise, payable to the order of J. F. Morrison, President, Baltimore, Md.

Electric Light Companies and Manufacturers of Electric Light Apparatus, supplies, etc., desiring to become members must apply on or before Aug. 31 to the President, J. F. Morrison, Baltimore, Md.

Members and others desiring information as to railroad transportation rates will address J. F. Noonan, Esq., Chairman Committee on Transportation, Paterson, N. J.

Special hotel rates will be made known previous to meeting of the Association.

A. J. DE CAMP,
Chairman Executive Committee, Philadelphia.

MODEL and EXPERIMENTAL WORK A SPECIALTY. Send for Circulars. **C. E. Jones & Bro.** CINCINNATI, O. (Mention this Paper.)

MAIN BELTING CO.,
MANUFACTURERS OF THE

Of the Greatest Traction Power; Has no Equal, in fact, is THE BELT. Strongest and Cheapest Belting in the World for Electrical Purposes.
MAIN BELTING CO. S. W. Cor. Ninth and Read Streets, **PHILADELPHIA, PA., U. S. A.**
AND 248 RANDOLPH STREET, CHICAGO, ILL.

LEVIATHAN COTTON BELTING.
Unsurpassed for Strength, Durability and Cheapness. Made to any Length, Width and Strength for Main Driving Belts. Endless Belts Made to Order. Correspondence Solicited.